DRAFT EVALUATION REPORTS

Executive Summary

Evaluation of the Asphalt Binder Quality Tester (TFPE-01)

Evaluation of the Exploratory Advanced Research (EAR) Program (TFPE-02)

Evaluation of Ultra-High Performance Concrete Connections (TFPE-03)

Evaluation Reports
prepared for

National Cooperative Highway Research Program
Transportation Research Board

of

The National Academies of Sciences, Engineering, and Medicine

January 31, 2022

RTI INTERNATIONAL

About the Research Program (R&T) Evaluation Program

The Federal Highway Administration (FHWA) "provides stewardship over the construction, maintenance and preservation of the nation's highways, bridges, and tunnels. FHWA also conducts research and provides technical assistance to state and local agencies in an effort to improve safety, mobility, and livability, and to encourage innovation" (https://www.fhwa.dot.gov/). A significant portion of FHWA's research activities, evolved over many years in response to successive legislative initiatives, is managed by agency staff from the R&T Program housed at the Turner-Fairbank Highway Research Center (TFHRC) in McLean, VA, and other locations. The aim of FHWA's R&T activities is to support FHWA's mission through deployment of innovations spawned by FHWA research.

To ensure that R&T activities are effectively and efficiently contributing to FHWA's mission, R&T staff apply leading practices in research management and occasionally undertake formal evaluations of select activities, projects, or programs. In addition, FHWA's R&T staff solicit advice from the Transportation Research Board (TRB), particularly the Research and Technology Coordinating Committee (RTCC). The RTCC issues annual reports commenting on R&T programs generally and suggesting adjustments to program strategies and approaches to improve program relevance, effectiveness, and impact.

In 2014, FHWA initiated the **R&T Evaluation Program** with two core objectives:

1. To evaluate the selection process by which research is funded, and
2. To assess the effectiveness of selected projects within the R&T portfolio, in terms of both research outcomes and technology transfer activities.

Under the R&T Evaluation Program's initial phase, 16 evaluations conducted by the Volpe National Transportation Systems Center were completed or in progress at the end of calendar year 2019. FHWA has asked TRB to undertake management of evaluations under a second stage of the R&T Evaluation Program. TRB's activities under this TRB-FHWA Program Evaluation (TFPE) effort comprise a series of projects evaluating research activities designated by FHWA and conducted by RTI International under TRB's direction and oversight. To date, the following projects have been initiated:

- **TFPE-01** Asphalt Binder Quality Tester
- **TFPE-02** Exploratory Advanced Research
- **TFPE-03** Ultra High-Performance Concrete Connections

These evaluations are intended to generate evidence and provide data-driven assessments that substantiate the contributions of FHWA's R&T Program to fulfilling the agency's mission and strategic goals. The evaluations are focused on estimating and forecasting the socioeconomic returns from investments in R&T Program activities to inform future research plans and improve technology transition outcomes. To this end, the evaluations include quantitative estimates of impact metrics. In addition, the evaluations provide input on data collection, tracking, and monitoring for ongoing program evaluation and improvement.

Asphalt Binder Quality Tester (ABQT) Evaluation: Executive Summary

This report presents the findings from an evaluation study conducted by the Transportation Research Board to assess the development process and potential economic impact of the Asphalt Binder Quality Tester (ABQT). The ABQT is a novel rapid testing device that measures the performance grading grade of asphalt binder by measuring deflection and recovery in a sample of asphalt binder. It has the potential to increase the detection of out-of-specification binder before it is used in asphalt pavement, thereby reducing road maintenance costs for asphalt roads.

The ABQT device was developed under a cooperative research and development agreement between the Federal Highway Administration (FHWA) and Laser Technology, Inc. The ABQT project was identified and scoped jointly by FHWA and LaserTech while they were jointly researching related laser testing technologies. As such, the ABQT development project was a spinoff of related research funded by FHWA and a collaborative development effort by the principals from this work. It was an opportunistic joint research venture that required FHWA leadership but modest FHWA investment. Many scientific and research advances are produced in such a manner, and these spontaneous public- and private-sector collaborations reflect the opportunistic and entrepreneurial nature of innovation in general.

ES.1 Evaluation Approach

The evaluation team conducted a total of 35 interviews with experts from organizations from six different stakeholder groups associated with the ecosystem that surrounds the ABQT device. Exhibit 1 provides a summary of the stakeholder organizations interviewed. The interviews were used to collect information on the process by which the ABQT device was developed and promoted and to collect data needed to quantify the potential economic impact of the device.

Exhibit ES-1. Subject Matter Expert (SME) Interviews by Stakeholder Group

Stakeholder Group	Number of Interviews Conducted
Asphalt binder suppliers	2
Asphalt mix plants	3
Owner agencies (state Departments of Transportation [DOTs])	17
Other private sector (e.g., consultants, private labs)	7
Research and academia	3
Industry trade associations	3

A probabilistic model was used to estimate the potential impact that adoption of the ABQT device could have on maintenance and replacement costs. Reduced road maintenance and replacement costs are the core of the monetized benefits calculated in the analysis. The model calculated how using the ABQT device as a screening tool can increase the probability of identifying out-of-specification binder and, hence, reduce the probability of using subpar binder, which leads to decreased maintenance and replacement costs.

ES.2 Findings

Based on interviews with SMEs, the most promising use case for the ABQT is use as a screening tool for quick tests on binder samples that either are not tested currently or have to go through more time-consuming and labor-intensive testing. For owner agencies (primarily state DOTs), the ABQT could be used as a quick screening test on the many samples they collect from contractors. The screening test could be conducted almost in real time as samples are received to potentially identify out-of-specification samples more quickly. The potential net benefits of using the ABQT as a screening tool could be sizable, over $300 million over a 15-year period of use for 50 state DOTs, and adoption by DOTs seems feasible.

Because of uncertainty of the ABQT device's acceptance and uptake, the evaluation team modeled three adoption scenarios. Exhibit 2 provides a summary of the discounted benefits, discounted costs, and net benefits for each of the three adoption scenarios. The FHWA investment to date has been approximately $400,000. If adoption levels across the three scenarios are achieved, the net annual benefits over the 15-year life expectancy of the ABQT device would be close to $8 million for each scenario. Scenario 1, adoption by state DOTs, has the largest net benefit. However, this is in part because DOTs are likely to be the first adopters, with suppliers and mix plants following their lead.

Exhibit ES-2. Summary of Economic Impact Analysis

	Scenario 1: DOTs	Scenario 2: Suppliers	Scenario 3: Mix Plants
Annual benefits	$9,441,000	$17,429,000	$21,424,000
Equivalent annual costs	$1,480,000	$4,392,000	$14,451,000
Net equivalent annual benefits	**$7,961,000**	**$13,037,000**	**$6,972,000**
Benefit-cost ratio	**6.0**	**4.0**	**1.5**
Rate of return (ROR)	**538%**	**297%**	**48%**

From the FHWA's perspective, the ROR to their investment has the potential to be quite high. For the DOT adoption scenario (Scenario 1), the FHWA's initial investment of $0.4 million has the potential to yield an annual return of $8 million. These figures are based on a high level of adoption by state DOTs. However, only two states adopting the ABQT are needed for the FHWA investment to break even.

From an individual DOT's perspective, the return on investment from adopting the ABQT as a screening tool depends on the number of asphalt lane-miles the state DOT is responsible for, which determines the resulting decrease in maintenance costs. Exhibit 3 shows how the returns vary for states with different numbers of asphalt lane-miles. For example, Michigan is the median state with about 20,000 thousand asphalt lane-miles. For Michigan, the use of ABQT is estimated to have a net annual benefit of about $111 thousand, which corresponds to an ROR of 380% and a benefit-cost ratio of 5. A large state like Texas has a much larger return. However, Hawaii, the state with the fewest asphalt lane-miles, has an ROR of −5% and a benefit-to-cost ratio a little under 1.

Exhibit ES-3. Return to State DOTs from Adopting the ABQT as a Screening Tool

Component	Returns for Different Size (Lane-Miles) States		
State	**Hawaii**	**Michigan**	**Texas**
State-owned asphalt road lane-miles	1,995	20,129	149,124
Units purchased	2	4	6
DOTs' purchase of ABQT device (onetime)	$76,000	$152,000	$228,000
DOT staff training (onetime)	$3,000	$6,000	$10,000

(continued)

Exhibit ES-3. Return to State DOTs from Adopting the ABQT as a Screening Tool (continued)

Component	Individual State DOT Total Costs		
DOT operating materials (annual)	$1,000	$2,000	$3,000
DOT maintenance (annual)	$2,000	$4,000	$7,000
DOT staff operation (annual)	$5,000	$10,000	$14,000
Total costs	$560,000	$174,000	$262,000
Component	**Individual State DOT Annual Costs/Benefits**		
Annual benefits	$14,000	$141,000	$1,041,000
Equivalent annual costs	$15,000	$29,000	$44,000
Net benefits	**–$1,000**	**$111,000**	**$998,000**
Benefit-cost ratio	**1**	**5**	**24**
ROR	**–5%**	**380%**	**2272%**

ES.3 Uncertainties

The analysis presented in this evaluation is a prospective assessment of the potential benefits of the ABQT if it is adopted as a screening tool to supplement the existing asphalt binder testing being conducted throughout the supply chain. As such, there is uncertainty around the magnitude of these potential net benefits. Throughout this evaluation report, we flag several parameters that might have the highest level of uncertainty. These parameters are ones that drive the probabilistic model that was used to calculate the annual benefits from using the ABQT device:

- The effectiveness of the ABQT device
- The percentage of samples collected by state DOTs that are tested (with the remaining not tested)
- The percentage of tested-failed samples that do not have an adverse effect on paved roads
- The percentage of increased maintenance costs from using out-of-specification binder

In an effort to reduce the uncertainty surrounding these key parameters, at the completion of the interviews, a subset of SMEs was asked to take an online survey to review the values of the key parameters used in the model. This semi-Delphi process shared back with state DOTs the average values for parameters obtained from the interviews. SME respondents were asked to comment on whether they thought the average/typical values identified during the interviews were representative for the industry as a whole (too high, too low, about right). In all instances, the SMEs thought the key parameter values used in the analysis were reasonable.

ES.4 Significance and Promoting Adoption

If adopted by stakeholders in the binder/asphalt sector, primarily state DOTs, the ABQT has the potential to deliver measurable reductions in the cost of maintenance for asphalt roads throughout the United States. The device is relatively low cost at about $38,000, is simple to use, and delivers results quickly (less than 1 hour). Although current asphalt binder quality is high and binder testing is extensive, even marginal improvement in the quality of the binder being paved and in testing effectiveness can have meaningful economic benefit. The ABQT would likely be one of many testing activities in the quality assurance toolkit. But, as shown by the quantitative finding, adoption of the device could have a nontrivial economic impact in terms of reduced maintenance costs.

However, the ABQT device will likely need additional marketing, demonstration, and promotional activities to gain meaningful adoption by DOTs, suppliers, and/or mix plants. Moving forward, FHWA could consider several activities to promote and increase adoption of the device. These are primarily related to technology transfer and information dissemination, which would not require significant additional investments by FHWA. Only minor technical enhancements/changes were recommended by SMEs for the device itself.

- Expanded access to demonstrating the device will be the most effective approach for increasing adoption.
- Engaging in the American Association of State Highway Transportation Officials standard specification process would increase the ABQT's visibility and credibility, while also increasing acceptance and adoption.
- Organizing a round robin testing program would help increase visibility and credibility.
- Investigating options that would reduce the up-front cost of the device to the user would help promote uptake. Options could range from establishing leasing programs to offering rebates for earlier adopters to looking for ways to reduce the production cost of the device itself.

Exploratory Advanced Research (EAR) Evaluation: Executive Summary

This evaluation of the Exploratory Advanced Research (EAR) Program examined the past investments made by the program as an approach to understanding and assessing the Program's management and operational processes, its output and outcomes, and its effectiveness at driving more significant impact on the US transportation research community and system. Within each of those three components (process, outcomes, and effectiveness), this study provides specific observations and options to consider as the program continues to evolve:

- Overall, the EAR Program makes effective use of the funding allocated for extramural research. The Program has focused on topics perceived to be of high potential value to FHWA and the surface transportation community. As an exploratory program, the EAR Program funds high-risk projects that often do not produce the expected outcomes. Still, EAR-funded research generated valuable outputs (especially in terms of new research frameworks, modeling techniques, and datasets), contributed to researcher training, and catalyzed follow-on research investments into the topics selected. Relative to its scale of funding and staff, the EAR Program created a robust network of stakeholders and partners within the FHWA and across federal and state governments, academia, industry, and the broader highway transportation community.

- A potential issue complicating program management is the instability in the EAR Program's budget from year to year. Based on funding availability, it is possible that well-qualified proposals submitted in a year with a lower budget would have been funded if submitted in a year with a higher budget. The budget instability also contributes to inconsistency across years in the proposal submission period and the ultimate award date for funded projects. These circumstances may discourage some proposers from submitting proposals to the EAR Program, as they have no information about the likelihood of receiving an award and may not receive information about new BAAs in a timely manner.

- The EAR Program could benefit substantially from a more robust infrastructure for record-keeping and project tracking to enable management of the program's overall portfolio of research investments, aligning them with the strategic goals for the Program and the FHWA. A portfolio management system would enable a view across multiple projects, budget years, and topic areas to show how the EAR Program's funding has been distributed across many areas of interest to FHWA. The system should also link projects to their key outputs (reports and other publications, patents, students trained, and research tools) and short-term outcomes, providing a more holistic view of the Program's value than found in the current reports on program results.

- With improved record-keeping, the EAR Program could do more targeted evaluation of its own processes and their results. It would be helpful to know, for example, whether better guidance on transition support leads to more effective assistance to PIs and more productive transition activities. Program records could also include immediate research outputs (journal articles, conference presentations, patents, and students trained) associated with each project, offering more insight into the dissemination of knowledge generated by the EAR Program.

- Ultimately, this evaluation is designed to examine whether the EAR Program has been designed and implemented in a manner that enables it to identify and support exploratory and advanced research topics. Proposers, reviewers, and stakeholders could benefit from more clarity on how they can determine what research topics appear to qualify as exploratory advanced research. While the uncertainty over the exact meaning of this term helps the EAR Program to maintain some flexibility and managerial discretion, it may also reduce confidence that the program supports research that could not be funded through other channels.

- In terms of outputs and outcomes, the EAR Program could be better equipped to trace its outputs and outcomes if it maintained a more systematic process for capturing data on outputs. Other federal research agencies have developed public access repositories for research literature published from funded projects. While this function could be provided through the National Transportation Library, the collection of information from PIs and research partners on articles published, patent applications filed, students trained, and other outputs would require additional resources and staff effort within the EAR Program.
- The EAR Program produces specific intangible benefits and impacts that are not communicated on a regular basis to stakeholders. The complementary relationship between EAR-funded projects and other research activities at FHWA R&T is highlighted occasionally in FHWA publications, but could be more clearly presented. These intangible benefits include the development of new research tools, software, and datasets that benefit the transportation research community. Tracking and publicizing these types of research outputs would highlight an aspect of the EAR Program that extends beyond its original mission to support potential breakthrough technology development.
- Since even the short-term outcomes of EAR-funded research may take years to emerge, periodic retrospective analysis would help the FHWA to capture those impacts and understand their significance. This information could be collected through periodic interviews or surveys of PIs on completed EAR-funded projects, and through conversations with external partners involved in previous EAR research efforts. That information could also be used to enhance current approaches to transition planning and communication strategies for active EAR projects, as it would help PIs and AOTRs to appreciate alternative pathways to generating positive results from EAR-funded research.

- The FHWA has several options for implementing better monitoring and assessment efforts to improve program processes. These options are covered in the process and outcome evaluations. In addition to those measures, the EAR Program may be able to clarify its criteria for determining what constitutes exploratory advanced research by revising its taxonomies for clustering topics and projects, and undertaking retrospective analysis of how those criteria have changed over the course of the program.
- A more fundamental issue is whether the FHWA wishes to assign exploratory advanced research a higher priority in the FHWA R&T system. Doing so would require a commitment to provide more substantial and reliable funding and other resources, enabling the program to gain greater visibility and leverage in the transportation research community. At a minimum, implementing some of the options for enhancement detailed in this report would require additional overhead funding and administrative support for the EAR Program staff. The program runs extremely efficiently with a very lean staffing plan, and assigning added responsibilities to the existing staff would exceed reasonable expectations.

Ultra-High Performance Concrete Evaluation: Executive Summary

This report presents the findings from an evaluation study conducted by the Transportation Research Board (TRB) to assess the potential socioeconomic impact of the use of ultra-high performance concrete (UHPC) for bridge connections in the United States and the work of the Federal Highway Administration (FHWA) Turner-Fairbank Highway Research Center (TFHRC) to encourage the deployment of the technology since 2002. UHPC is a cementitious composite material with higher compressive, tensile, and flexural strength, lower permeability, and improved durability than conventional concrete. The UHPC Research and Development Program at the TFHRC has conducted research and produced reports, technical briefs, and guidelines for the use of UHPC, leading to its use in multiple bridge applications, predominantly for prefabricated bridge element (PBE) deck-level connections.

Because of the relative benefits and costs of UHPC compared with conventional concrete described in this report, TFHRC has focused mostly on encouraging the adoption of UHPC connections (UHPC-C). TFHRC has focused on expanding the use of UHPC-C through research and publication efforts, including disseminating information through workshops and "consulting" informally with state and local transportation departments. The TFHRC labs are also among the few in the United States with the tools for conducting large-scale concrete structural testing and for characterizing materials.

ES.1 Evaluation Approach

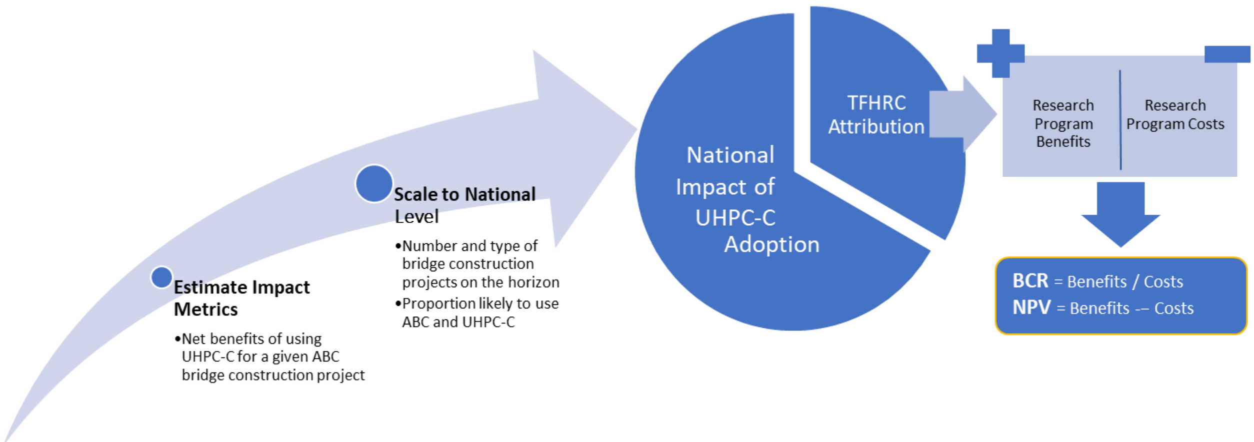
The evaluation focuses primarily on the impacts of UHPC-C compared with conventional concrete connections (CC-C) for deck-level PBEs and has three core objectives.

1. Review the process by which the TFHRC selected UHPC-C as a research focus, assess the effectiveness of its activities in promoting UHPC-C adoption, and document program accomplishments and UHPC-C deployment milestones.
2. Assess the technical and business cases for using UHPC-C, the barriers to adoption for construction stakeholders, and the potential role for TFHRC in addressing those barriers.
3. Quantitatively estimate the benefits and costs of UHPC-C to determine the socioeconomic return from adoption.

The evaluation team reviewed existing literature on the use and benefits of UHPC-C and aggregated publicly available bridge construction data to quantify the potential socioeconomic impact of the use of UHPC-C. The evaluation team also conducted 16 interviews with subject matter experts from organizations within six stakeholder groups associated with the bridge delivery process. The interviews were used to collect information on the process by which the TFHRC UHPC research was developed and promoted and to corroborate the findings from the reviews of existing literature and public databases.

Exhibit 1 summarizes the methods used to quantify socioeconomic impacts of UHPC-C adoption. Net benefits were calculated by estimating the benefits and costs associated with adopting UHPC-C compared with CC-C per square foot of a typical accelerated bridge construction (ABC) bridge project. Net benefits are expressed in terms of dollars per square foot of bridge and then scaled to the aggregate square footage of existing and potential future bridge projects using UHPC-C to estimate national benefits. The proportion of these benefits attributable to TFHRC activities is compared with TFHRC UHPC-C research costs to determine the national-level return on the TFHRC investment.

Exhibit 1. UHPC-C Socioeconomic Impact Quantification Methods



ES.2 Findings

The evaluation results suggest substantial benefits of UHPC-C use and strong positive national-level returns to TFHRC UHPC-C research activities. Our hypothesis is that the main outcome of TFHRC activities and outputs is the increased adoption of UHPC-C, contributing to the increased adoption of PBE deck slabs (mostly for ABC applications). Based on our review of cost estimates from a subset of bridges in Florida International University's (FIU's) ABC Project Database, we estimated that the average onetime net benefit of using UHPC-C for construction is $8 to $18 per square foot of bridge. Data on average annual rehabilitation costs per square foot of bridge from Kentucky and New York imply an added annual benefit of $1 to $4 per square foot per year.

Exhibit 2. Number of U.S. Bridges Built Using UHPC-C per Year from 2011 through 2018

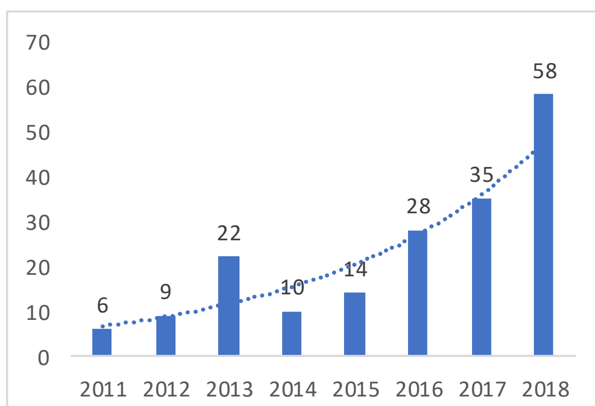


Exhibit 2 shows the number of U.S. bridges built using UHPC-C per year from 2011 through 2018. We applied the UHPC-C benefits per square foot of bridge to the total square footage of these bridges, generating an aggregate present value of realized UHPC-C benefits of $22.4 million to $55.3 million. We applied the observed trends in UHPC-C adoption to National Bridge Inventory data on bridge conditions to estimate the potential number of bridge projects to be completed using UHPC-C between 2019 and 2028 along with the aggregate square footage of these bridges. We then applied the UHPC-C benefits per square foot of bridge to the projected square footage of bridges built using UHPC-C between 2019 and 2028 to generate a future present value of UHPC-C benefits of $56.5 million to $142.3 million.

Interviews with industry stakeholders indicate that TFHRC research and outreach activities offered high value and influence on the adoption of UHPC-C. A high percentage of the benefits could be attributed to the work TFHRC has done to promote UHPC-C use: conservatively, over 75% because most respondents attributed virtually all U.S. UHPC-C deployments to TFHRC technology transfer efforts, either in the form of research or dissemination. To remain conservative, we applied a range of 60% to 75% TFHRC attribution.

Exhibit 3. Present Value of Realized and Potential UHPC-C Benefits from 2011 through 2028 Attributable to TFHRC

Present Value of Benefits ($2021)	Low UHPC-C Benefits x 60% TFHRC Attribution	High UHPC-C Benefits x 75% TFHRC Attribution
Realized	$13,409,000	$41,499,000
Potential	$33,888,000	$106,726,000
Total	$47,927,000	$148,225,000

Exhibit 3 shows the realized and potential future present value of benefits that are reasonably attributable to the efforts of TFHRC. Results indicate total UHPC-C benefits attributable to TFHRC of $47.9 million to $148.2 million.

From the perspective of FHWA, the return on the TFHRC investment is substantial. TFHRC's estimate of the expenditures specific to UHPC-C was $2,545,000 total between 2009 and 2017. The present value of these costs, assuming an even distribution of costs over time, is $3.1 million.

Exhibit 4. NPV and BCR of TFHRC UHPC-C Research

	Low	High
Realized Benefits (2011–2018) versus TFHRC Costs (2009–2017)		
NPV ($2021)	$10,302,000	$38,392,000
BCR	4.3	13.4
Realized and Potential Benefits (2011–2028) versus TFHRC Costs (2009–2017)		
NPV ($2021)	$44,189,000	$145,118,000
BCR	15.2	47.7

Exhibit 4 summarizes the net present value (NPV) and the benefit-cost ratio (BCR) of TFHRC's research activities. Comparing TFHRC UHPC-C research costs with the realized and future benefits of UHPC-C attributable to TFHRC, our analysis suggests an NPV of $44.2 million to $145.1 million and a BCR of 15.2 to 47.7.

ES.3 Uncertainties

Interviews suggested that the net benefits of UHPC-C depend on bridge project characteristics, including the level of traffic, climate, and exposure to water. To reflect some of the diversity among projects, we modeled UHPC-C adoption by region and crossing feature. However, bridge construction and maintenance cost estimates in this report were derived from limited data available in public bridge databases and existing literature and thus were assumed to be constant across bridge applications throughout the United States. Material and labor costs can also vary greatly by contractor, even in bids for the same project. More representative and diverse data on bridge construction costs and benefits with and without UHPC-C would allow for more specificity in these estimates.

Additionally, we used the monetary disincentives that owner agencies sometimes attach to construction contracts as a lower-bound proxy for the impacts of traffic congestion. Disincentives are stipulated by hour or by day to encourage contractors to complete construction on schedule. As such, they reflect the owner agencies' perception of the value of each day of traffic disruption. We argue these are reasonable lower bounds for the impacts of field construction time because owners are most likely to consider the value of time to people and trade, somewhat likely to consider reduced risk of traffic or worker accidents, and unlikely to consider the cost of added emissions.

Finally, the benefits and costs of UHPC-C use estimated in this report should not be applied to other applications of UHPC. Net benefits of using UHPC versus conventional concrete may vary based on the quantity of material needed and the expected performance benefits for each application.

ES.4 Significance and Promoting Adoption

Stakeholder interviews indicated strong agreement about the high effectiveness of TFHRC's UHPC-C technology transfer efforts. Across multiple stakeholder groups, interviewees went out of their way to describe how helpful TFHRC had been in promoting and supporting the adoption of UHPC-C. Several interviewees said that they felt the current U.S. adoption of UHPC-C could be attributed almost entirely to TFHRC's efforts. Stakeholders did note that proprietary UHPC suppliers carry out their own stakeholder outreach efforts but indicated that FHWA, as a highly respected and unbiased source of information, likely had the most influence on UHPC-C adoption in the United States. Many researchers and owner agencies recognized TFHRC as both the preliminary and primary source of information for them about UHPC-C, initiating their engagement with the material and serving as a continuing guide for best practices through workshops, Every Day Counts (EDC) initiatives, research publications, and technical reports.

The key remaining barriers to adoption of UHPC-C are the high costs of the material itself and of the needed equipment and labor required to apply the material. Interviewees suggested that additional TFHRC standards for producing and testing generic UHPC mixes could help decrease materials costs. Interviewees also suggested that additional demonstration projects could help contractors increase their familiarity with UHPC-C application best practices in varying field conditions. Such demonstration projects would also allow owner agencies to observe performance benefits. Increasing and synthesizing data on bridge costs and benefits would better allow the results of UHPC-C applications to be observed by owners and industry throughout the United States.