

NTC Program Progress Performance Report (PPPR) Information Form

For P.I.'s Use

On a semi-annual basis the NTC sponsored P.I. must report Program Progress Performance Report (PPPR) using the format specified in this PPPR Information Form. The form must be submitted electronically to the corresponding NTC Associate Director by **9/16/2016**.

Cover Period: 4/01/2016 – 9/30/2016

NTC Funded Project Information (Round/Year 3, 2015-2016)	
University Name	Arizona State University
Project Title	Economic Impacts from Challenges in Pavement Engineering in an Uncertain Climate Future
Principal Investigator	Shane Underwood (ASU); Mikhail Chester (ASU)
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The form includes the following six parts:

- Part I – Performance Indicators
- Part II – Accomplishments: What was done? What was learned?
- Part III – Products: What has the program produced?
- Part IV – Participants & Collaborating Organizations: Who has been involved?
- Part V – Impact: What is the impact of the program? How has it contributed to transportation education, research and technology transfer?
- Part VI – Changes/Problems

Supplementary documents/materials can be attached to this form with the submission.

Part I – Performance Indicators	
Reporting Period	4/01/2016 – 9/30/2016
1. Transportation-related courses offered during the reporting period that were taught by faculty and/or teaching assistants who are associated with the UTC	
Undergraduate courses	Shane Underwood: Pavement Analysis and Design (412) Mikhail Chester: Transportation Systems Planning (474)
Graduate courses	Shane Underwood: Pavement Analysis and Design (511) Mikhail Chester: Transportation Systems Planning (598)
2. Students supported by this grant	
Undergraduate students	None
Masters students	Madhur Soam
Doctoral students	None
3. Students participating in transportation research projects funded by this grant (but not supported by this grant)	
Undergraduate students	None
Graduate students	None
4. Students supported by this grant who received degrees	
Undergraduate degrees	Yarden Feinberg
Masters degrees	None
Doctoral degrees	None
Part II – Accomplishments: What was done? What was learned?	
The information provided in this section allows the OST-R grants official to assess whether satisfactory progress has been made during the reporting period.	

Reporting Period	4/01/2016 – 9/30/2016
1. What are the major goals of the program?	<p>The National UTC aims to promote strategic transportation policies, investment, and decisions that bring lasting and equitable economic benefits to the U.S. and its citizens. The Center is concerned with the integrated operations and planning of all modes serving the nation’s passenger and freight transportation system, including the institutional issues associated with their management and investments. A balanced multi-modal approach will be used that considers freight and passenger travel mobility, reliability, and sustainability, as well as system operations during periods of both recurring and non-recurring incidents, including response to major emergencies. The modes in this theme include highway, transit, rail, and inter-modal interfaces including ports, terminals and airports. In particular, the center focuses on research, education, and technology transfer activities that can lead to (1) Freight efficiency for domestic shipping and for our international land, air, and sea ports; (2) Highway congestion mitigation with multi-modal strategies; and (3) Smart investments in intercity passenger travel facilities such as high speed rail. Major center activities are as following:</p> <ul style="list-style-type: none"> • Advanced & Applied Research Promoting Economic Competitiveness: Our research activities are multimodal/intermodal and multidisciplinary in scope, with the aims of addressing nationally and regionally significant transportation issues pertinent to economic competitiveness and providing practice-ready solutions. • Education, Workforce Development, Technology Transfer, & Diversity The consortium is committed to providing high-quality transportation education and workforce development programs for a broad and diverse audience. Center’s efforts will support the development of a critical transportation knowledge base and a transportation workforce that is prepared to design, deploy, operate, and maintain the complex transportation systems of the future.
2. What was accomplished under these goals?	This study will integrate climatological forecasts into pavement analysis to develop an economic assessment of pavement performance over time in order to identify how engineers can

	<p>improve the reliability and reduce the life cycle costs of roadways in an uncertain climate-impacted future. The scope of this study will be with respect to high truck volume interstate pavements. A database of pavement design conditions for the entire length of 26 different interstates will be used for this study. The anticipated outcomes from this research project will be:</p> <ul style="list-style-type: none"> • An improved understanding of the interactions between climate projections and their expected impact on the pavement infrastructure; • Quantified analysis of the effects of currently projected climate trends on pavement infrastructure in the United States; • A national economic analysis disaggregated by region and agency versus user/freight impact costs, on the expected impacts from pavement engineering challenges in an uncertain climate future. <p>Alternative pavement design/analysis strategies that to mitigate the economic impacts to private and commercial users given in the face of climate uncertainties.</p>
<p>3. How have the results been disseminated?</p>	<p>Preliminary analysis of the study results was submitted as a journal publication to the Transportation Research Board (TRB) 96th annual meeting.</p>
<p>4. What do you plan to do during the next reporting period to accomplish the goals? (10/1/2014 – 09/10/2016)</p>	<p>In the upcoming period we will be focusing on the impacts of projected temperature changes on the pavement infrastructure and evaluation of economic impact associated with it.</p>

Part II – Products: What has the program produced?

Publications are the characteristic product of research projects funded by the UTC Program. OST-R may evaluate what the publications demonstrate about the excellence and significance of the research and the efficacy with which the results are being communicated to colleagues, potential users, and the public, not the number of publications. Many research projects (though not all) develop significant products other than publications. OST-R may assess and report both publications and other products to Congress, communities of interest, and the public.

Reporting Period	4/01/2016 – 9/30/2016
1. Journal publications:	
2. Books or other non-periodical, one-time publications	
3. Other publications, conference papers and presentations	<p>Paper titled “Impact of Climate Change on the Pavement Performance and Its Sensitivity to Various Climate Prediction Models” was submitted to the Transportation Research Board (TRB) 96th annual meeting. (Under review)</p> <p>Authors: Shane Underwood, Padmini Gudipudi, Ali Zalgout</p> <p>Acknowledgement of federal support: Yes</p>
4. Website(s) or other Internet site(s)	None thus far
5. Technologies or techniques	None thus far
6. Outreach activities	None thus far
7. Courses and workshops	Will be integrated in 2016 Fall pavement design course
8. Inventions, patent applications, and/or licenses	None
9. Other products	None thus far

Part III – Participants & Collaborating Organizations: Who has been involved?

OST-R needs to know who has worked on the project to gauge and report performance in promoting partnerships and collaborations.

Reporting Period	4/01/2016 – 9/30/2016
1. What organizations have been involved as partners?	None thus far
2. Have other collaborators or contacts been involved?	None

Part IV – Impact: What is the impact of the program? How has it contributed to transportation education, research and technology transfer?

DOT uses this information to assess how the research and education programs:

- increase the body of knowledge and techniques;
- enlarge the pool of people trained to develop that knowledge and techniques or
- put it to use; and,
- improve the physical, institutional, and information resources that enable those people to get their training and perform their functions.

Reporting Period	4/01/2016 – 9/30/2016
1. What is the impact on the development of the principal discipline(s) of the program?	This research directly addresses economic competitiveness. The construction and maintenance of highway infrastructure represents a substantial burden for state and local transportation agencies. Proper planning and design of this infrastructure can reduce these costs and permit more effective distribution of funds. States and regions experiencing greater climatological changes may be particularly vulnerable and face substantial hurdles to remain economically competitive. Nationally, ensuring that current transportation infrastructure investments are strategically directed so as to mitigate these uncertainties (by investing in major commercial routes that are along corridors less prone to future climate uncertainties for example) may lead to a more resilient transportation infrastructure that maintains and improves the global economic competitiveness of the country. The findings from this study will add another dimension to the discussion of climate projections as it directly addresses the expected impacts on pavement infrastructure. It will provide an assessment of the do-nothing scenario wherein procedures do not change as well as establish a framework for future studies that may establish goals for infrastructure design and construction and/or development of new materials technologies to ensure effective long-term development of the transportation infrastructure.
2. What is the impact on other disciplines?	This research will impact disciplines focusing on infrastructure challenges in uncertain climate futures. As such it is of interest to disciplines focused on infrastructure planning.
3. What is the impact on the development of transportation	This study has provided funding for a graduate student in Transportation engineering and an undergraduate student in Mathematics.

workforce development?	
4. What is the impact on physical, institutional, and information resources at the university or other partner institutions?	Unsure
5. What is the impact on technology transfer?	These results will affect the decision making scope when designing and delivering infrastructure. This information can be disseminated to planners and others responsible for making decisions on pavements and their impact on local and regional economies.
6. What is the impact on society beyond science and technology?	The study results may be used in coordination with the Summer Transportation Institute (a program that engages high school students from low income rural areas in Arizona in Transportation careers).
7. Additional impacts	The anticipated outcomes from this research project will be an improved understanding of the ways that engineers can better design and deliver infrastructure. This analysis will demonstrate, quantitatively in terms of dollar costs the impacts from a do-nothing, business as usual scenario and more proactive strategies.

Part V – Changes/Problems

If not previously reported in writing to OST-R through other mechanisms, provide the following additional information or state, “Nothing to Report, if applicable:

Reporting Period	4/01/2016 – 9/30/2016
1. Changes in approach and reasons for change	Nothing to Report
2. Actual or anticipated problems or delays and actions or plans to resolve them	Nothing to Report
3. Changes that have a significant impact on expenditures	Nothing to Report
4. Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards	Nothing to Report
5. Change of primary performance site location from that originally proposed	Nothing to Report