

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 **9/15/2015**.

Cover Period: 4/1/2015 – 9/30/2015

| NTC Funded Project Information (Round/Year 2, 2014-2015) | |
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| University Name | Old Dominion University |
| Project Title | Open Toll Lanes in a Connected Vehicle Environment: Development of New Pricing Strategies for a Highly Dynamic and Distributed System – phase II |
| Principal Investigator | Mecit Cetin |
| PI Contact Information | mcetin@odu.edu |

The form includes the following six parts:

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

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

Part I – 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 4/1/2015 – 9/30/2015

1. What are the major goals of the program?

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:

- **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.

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| <p>2. What was accomplished under these goals?</p> | <p>Our research focuses on the mitigation of Highway congestion through the use of multi-location auction tolling in an future environment were drivers are able to use vehicle-to-infrastructure (V2I) to communication to the toll operator. The system of our research interest was defined in this reporting period. The second phase of the project has been split into three strands: (1) collect of toll user information through surveys (2) development of analytical solutions and (3) the development of a simulation tool to explore this potential future transportation scenario. The analytical solutions to the scenario will build upon those found in the first phase of the project.</p> <p>The phase II of this project will include development of behavioral surveys to gain insights into how people would choose to travel on toll roads when given the opportunity to bid. This information will be used to produce an agent-based model (ABM) using the new Agent_Zero framework, proposed by Joshua Epstein (2014), the world’s leading ABM researcher, as a means to model human behaviors. This research approach will likely produce more realistic results on tolling in the connected vehicle environment.</p> <p>The project team brings together individual researchers from a diverse background and skillset. Apart from transportation engineering, the project team consist of Modeling and Simulation academics, an Operations Researcher and a Social Scientist.</p> |
| <p>3. How have the results been disseminated?</p> | <p>The project team is currently collecting data for the project and no information has been disseminated for this phase of the project (though information has been disseminated for the first phase).</p> |
| <p>4. What do you plan to do during the next reporting period to accomplish the goals? (10/1/2014 – 3/10/2015)</p> | <p>The key focus of the next six months is the development of a survey instrument to collected stated preference information about driver’s attitudes to tolling and new tolling mechanisms.</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.

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| Reporting Period | 4/1/2015 – 9/30/2015 |
| 1. Journal publications: | Collins, A. J., E. Frydenlund, R. M. Robinson and M. Cetin (2015). “Exploring a Toll Auction Mechanism Enabled By Vehicle-To-Infrastructure Technology.” <u>Transportation Research Record: Journal of the Transportation Research Board</u> , in press (accepted February 2015). ISSN: 0361-1981 |
| 2. Books or other non-periodical, one-time publications | N/A |
| 3. Other publications, conference papers and presentations | Collins, A. J., E. Frydenlund, R. M. Robinson and M. Cetin (2016). “Comparing Value of Time Distributions in a Tolling Auction Mechanism Enabled by Vehicle-To-Infrastructure Technology.” 95th Transportation Research Board Annual Meeting, Washington, D.C., January 10-14, 16-5030 (submitted) |
| 4. Website(s) or other Internet site(s) | N/A |
| 5. Technologies or techniques | N/A |
| 6. Outreach activities | N/A |
| 7. Courses and workshops | N/A |
| 8. Inventions, patent applications, and/or licenses | N/A |
| 9. Other products | N/A |

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.

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| Reporting Period | 4/1/2015 – 9/30/2015 |
| 1. What organizations have been involved as partners? | This project is currently conducted at ODU as a collaborative effort between faculty from Civil Engineering Department and the Virginia Modeling, Analysis and Simulation Center (VMASC). |
| 2. Have other collaborators or contacts been involved? | Dr. Lei Zhang from the University of Maryland has joined the team for this phase II work. His expertise on congestion pricing, agent-based modeling, and simulation are particularly relevant to the Phase II of the project. |

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.

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| Reporting Period | 4/1/2015 – 9/30/2015 |
| 1. What is the impact on the development of the principal discipline(s) of the program? | Tolling lanes and High Occupancy Vehicle lanes (HOV) have long been used as mechanism to relieve traffic congestion as well as a mechanism to generate funds to build new facilities to further reduce congestion. By investing a possible tolling mechanism, involving V2I technology, will provide decision-makers with information, not available through empirical means, to generate and implement appropriate policy. The analytical models provide an understanding of how a private toll operator might use the derived tolling mechanism to maximize profit and thus appropriate policy could be put in place to ensure that other goals of the toll (i.e., reduction of congestion) are also met. |
| 2. What is the impact on other disciplines? | Incorporating an auction tolling mechanism within a transportation simulations helps bridge the gap between economics/revenue management and transportation research. The project team has to develop new ideas and approach that incorporating not only driving behavior but also an individual’s economic behavior. |
| 3. What is the impact on the development of transportation workforce development? | Through the graduate course taught related to this project, new graduates have obtained the skills necessary to engage in the transportation community and workforce, especially in the area of Modeling and Simulation. The course were taught at Old Dominion University which graduate study current mission includes “A diverse graduate student body broadens the talent pool and best serves the interests of higher education and our nation.” |

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| 4. What is the impact on physical, institutional, and information resources at the university or other partner institutions? | N/A |
| 5. What is the impact on technology transfer? | N/A |
| 6. What is the impact on society beyond science and technology? | The development of a practical data-collection game has begun on the project to investigate the tolling actions of real individuals in a simulated environment. This game will not only collect data but will allow a discussion with individuals outside the project on their reaction to auction-based tolling. It is hoped that introducing the potential new technology to the public before it deployed will help shape the policy relating to it. |
| 7. Additional impacts | By using V2I technology to allow drivers to bid on toll road prices will produce a competitive pricing for the toll road as opposed to a pricing scheme set by the toll operator. This will also allow drivers to communicate their desire to use the toll road, through the bids they make, giving them input into the pricing scheme for using the toll road. |

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:

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| Reporting Period | 4/1/2015 – 9/30/2015 |
| 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 |