State Planning & Research Part II Work Program

Research, Development, & Technology Transfer Program

Fiscal Year 2021

Original Submission

In Cooperation with the US Department of Transportation
and Federal Highway Administration

GOVERNMENT OF THE
DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

SPR Part II Work Program

Research, Development, & Technology Transfer Program
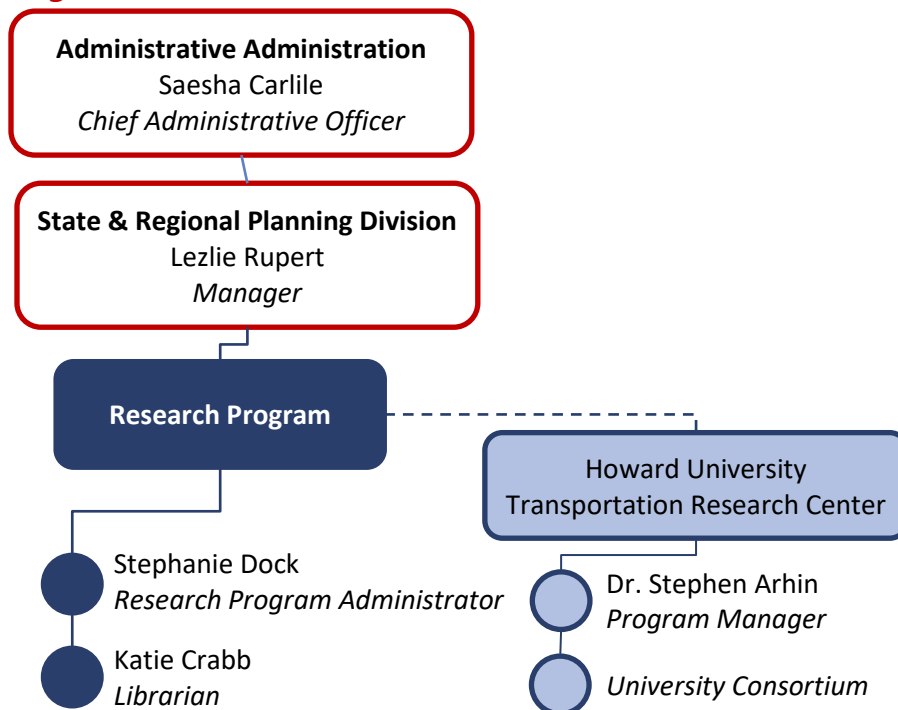
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Overview

Title 23 of the United States Code provides federal funding for state research programs by requiring that at least a minimum of ½ percent of certain federal funds apportioned to a state be used for research, development, and technology transfer (RD&T) programs. These activities involve research on new areas of knowledge, adapting findings to practical application by developing new technologies and the transfer of these technologies, including the process of dissemination, demonstration, training, and adoption of innovations by users.

This work program identifies the work to be accomplished and cost estimates by activity for the use of State Planning & Research (SPR) funds for research purposes during Fiscal Year 2021.

Mission

The mission of the District Department of Transportation's (DDOT) Research Program is to facilitate and promote innovative transportation research, implementation, outreach, and technology transfer activities in order to improve the efficiency and effectiveness of DDOT's service delivery. To do this, the Research Program convenes and guides a structured approach to research, provides research material, and manages research projects.

Organization Chart

Administrative Administration
Saesha Carlile
Chief Administrative Officer

State & Regional Planning Division
Lezlie Rupert
Manager

Research Program

Howard University
Transportation Research Center

Stephanie Dock
Research Program Administrator

Katie Crabb
Librarian

Dr. Stephen Arhin
Program Manager

University Consortium

DDOT Statement of Compliance

I, Saesha Carlile, Chief Administrative Officer of the District Department of Transportation, do hereby certify that the District is in compliance with all requirements of 23 U.S.C. 505 and its implementing regulations with respect to the research, development, and technology transfer program, and contemplate no changes in statutes, regulations, or administrative procedures which would affect such compliance.

Saesha L Carlile

Saesha Carlile
Chief Administrative Officer
District Department of Transportation

Proposed Funding

Estimated SPR Part II Funding in FY2021

Line Item	Description	Salary	Fringe	Total	Federal	District
	Research Program Administrator	$149,679	$32,742	$149,679	$119,743	$29,936
	DDOT Librarian	$93,930	$20,547	$93,930	$75,144	$18,786
2021-01	**Research Program Administration and In-House Research Subtotal**	**$243,610**	**$53,290**	**$243,610**	**$194,888**	**$48,722**
2021-02	Academic & Administrative Support Services			$253,039	$202,432	$50,608
2021-03	Collaborative Research (TRB + Pooled Fund)			$141,500	$126,100	$15,400
2021-04	Quick Response and Literature Reviews			$85,000	$68,000	$17,000
2021-04	Research Projects[1]			$779,879	$594,920	$148,730
	Contractual Services Subtotal			**$1,259,418**	**$991,452**	**$231,738**
	IDCR (8.5%)[2]			**$122,275**	**$97,820**	**$24,455**
	TOTAL			**$1,625,303**	**$1,284,159**	**$304,915**

[1] There are both new and continuing projects that have new funding in FY2021.

[2] IDCR does not apply to Pooled Fund contributions

01 Research Program Administration and In-House Research

Work Item Budget	Total Amount:	$243,610
	Federal Portion:	$194,888
	District Portion:	$48,722

Line Item Budget Details:
- **Manager**: Stephanie Dock, Research Program Administrator, State & Regional Planning Divisions
- **Work Conducted By**: DDOT Staff
- **Planned Completion**: October 2021

Line Item	Positions	$/Hr. (w/benefits)	Hours	Estimated Cost FY20
2021-011	Research Program Administrator	$71.96	2,080	$149,679
2021-012	DDOT Librarian	$45.16	2,080	$93,930

Funding Category Purpose & Objectives

The Research Branch is responsible for encouraging, managing and implementing all Research Program activities. The branch is comprised of a program administrator and a librarian. This work program covers one year of fully loaded staff salaries.

The Research Program, with the support of the FHWA Division Office, has been working on returning to program fundamentals for the last several years. Critical activities for a continued emphasis on this are:
- Finishing the close out on earlier work program federal aid projects (FAPs) as projects complete
- Continuing to revise and expand the standard operating procedures for program activities

Staff will continue to support core program activities funded through this budget, namely:
- Monitoring active research projects from prior work programs
- Administering the university support contract, including re-soliciting the contract this year
- Managing the research internship program
- Managing the DDOT Library and library services
- Coordinating the TRB relationship
- Supporting agency research and innovation efforts, through the State Transportation Innovation Council and Every Day Counts initiatives, market scans, and assisting with research funding applications as appropriate
- Conducting internal research

Line Item 2021-011
Title: Research Program Administrator

The Research Program Administrator oversees the development, coordination, management, and administration of the federally funded SPR Part II transportation research program. Prepares the annual work program and prepares quarterly and annual progress reports on the work program. Reviews research problem statements, proposals, and work plans for research projects. Attends administrative or technical meetings and workshops associated with research, development, and technology transfer. Serves as TRB State Representative and EDC Coordinator.

Conducts in-house research. Expected projects and activities this year include:
- Leading the technical side of the re-solicitation of the university support contract
- Implementing findings from the research peer exchange
- Getting new research projects underway and ensuring older projects are fully closed out
- Supporting evaluations of pilots and demonstrations led by other DDOT staff
- Advancing data governance efforts to support research and pilot projects

Line Item 2021-012
Title: DDOT Librarian

The DDOT Librarian manages the DDOT Library and provides library services to the agency, including conducting literature reviews, digitization of the archives, and cataloging and making available DDOT's research (as well as national research). Assists external researchers seeking to use DDOT's collections (generally archival materials). Manages the intern program and supports the Research Program Administrator in other program activities and in-house research.

Expected projects and activities this year include:
- Digitization of the DDOT archives and posting through the DDOT Back in Time website.
- Library collection management – refine and identify funding for acquisitions plan, implement weeding plan to de-accession items not needed in preparation for eventual office relocation.

02 Academic and Administrative Support Services

Work Item Budget	Total Amount:	$253,039
	Federal Portion:	$202,432
	District Portion:	$50,608

Line Item Budget Details:
- **Manager**: Stephanie Dock, Research Program Administrator, State & Regional Planning Division
- **Work Conducted By**: Howard University and new contract holder (if lead changes)
- **Planned Completion**: October 2021

Line Item	Description	Estimated Cost FY20
2021-021	Administrative Support	$125,039
2021-022	Peer Reviewers	$8,000
2021-023	Research Internship Program	$120,000

Funding Category Purpose & Objectives

The Research Program utilizes the resources of area universities to expand the program's capacity and to support transportation research at those universities. HUTRC leads a consortium of local universities to support the Research Program. The funding category covers compensation for the staff at HUTRC for their time to support DDOT and administer the consortium and the internship program; costs of the internship program; and support for the peer exchange DDOT will conduct this year.

Line Item 2021-021
Title: Transportation Research, Evaluation and Technology Development

University costs are assumed to include applicable overhead rates and fringe benefits for staff salaries. Typically, the program support staff salaries are paid from this budget area. Where university staff members paid from this budget are engaged as Principal Investigators on research projects, those projects will be conducted at a reduced cost.

This cost estimate assumes partial salaries for 3 staff at Howard University (program director and 2 other staff) from January to December.

Line Item 2021-022
Title: Peer Reviewers

Expert peer reviewers are engaged to support research projects and ensure quality products by reviewing methodology, interim deliverables, and the final report. Reviewers are offered a small stipend

in return for their time for projects, based on the expected level of engagement. Estimate assumes 2 paid reviewers per project for 3 projects.

Line Item 2021-023
Title: Transportation Research Internship Program

The internship program is administered by the university, who is responsible for recruitment, hiring, and payment. Intern research projects are identified throughout DDOT and intern work is overseen by agency staff. The cost estimate for the internship program is based on ten full time interns during the summer and three part-time interns during the semester, though the exact numbers of interns will vary based on level (graduate/undergraduate), number of requests, and available budget.

03 Collaborative Research Efforts

Work Item Budget	Total Amount:	$141,500
	Federal Portion:	$126,100
	District Portion:	$15,400
	Other Funds:	$25,000

Line Item Budget Details

Line Item	Description	Estimated Cost FY20	Prior Contributions	Expected Future Contributions	Total Cost Estimate
2021-031	TRB Dues	$77,000	Annual	Annual	$77,000
TPF-5(370)	Fostering Innovation in Pedestrian and Bicycle Transportation	$25,000	$75,000	$25,000	$125,000
TPF-5(440)	Support for Urban Mobility Analyses	$0	$25,000	$0	$50,000
TPF-5(455)	National Accessibility Evaluation Phase II Access Across America	$36,000	$0	$144,000	$180,000
TPF-1530	Research Project Tracking System	$3,500	$0	$0	$50,000

Funding Category Purpose & Objectives

This work item covers collaborative research efforts in which DDOT participates. The Research Program pays the costs for TRB dues and contributes to Transportation Pooled Fund (TPF) projects. DDOT is currently committed to three pooled fund studies, two of which are paid from SPR Part II funds and are listed below with their TPF numbers.

Project 2021-031
Title: TRB Dues

This item is for the District's dues to TRB. This amount is an estimate for the July 2021-June 2022 dues, assuming a small increase from prior years. These funds are paid to TRB directly, not via the pooled fund mechanism

- **Manager**: Stephanie Dock, Research Program Administrator, Planning & Sustainability Division
- **Work Conducted By**: Transportation Research Board
- **Planned Completion**: Funds transferred by September 30, 2021
- **Estimated Cost**: $77,000

Project TPF-5(370)
Title: Fostering Innovation in Pedestrian and Bicycle Transportation

The overall goals for this Transportation Pooled Fund (TPF) study are to: 1. Provide answers to emerging questions about innovative facility design, planning, and implementation to improve safety and mobility for pedestrians and bicyclists. 2. Conduct effective and efficient research of innovative traffic control devices to accelerate their incorporation into the Manual on Uniform Traffic Control Devices (MUTCD). 3. Facilitate the collection and reporting of robust transportation facility data that will allow for updating Federal, State, local, and other design guidelines, such as the American Association of State Highway and Transportation Officials (AASHTO) design guides. 4. Support research on addressing rural multimodal transportation needs, regulatory streamlining, opportunities to improve cost effectiveness and efficiencies in the transportation system, and multimodal investment analysis.

DDOT has participated in this study since its inception in 2017 and has contributed to 4 of the 5 years. DDOT expects to contribute to the final, 5th year of the program in 2021. This project is approved for 100% SPR funds and therefore no District share is included for this project.

- **Manager**: Mike Goodno, Bicycle Program Specialist, Planning & Sustainability Division
- **Lead Agency**: Federal Highway Administration
- **Planned Completion**: Funds transferred by August 2021; project is ongoing through 2021.
- **FY2021 Contribution**: $25,000

Project TPF-5(440)
Title: Support for Urban Mobility Analyses

The pooled fund study scope focuses on mobility and reliability performance measures, data and issues. New emphasis areas include emerging data sources, freight movement, arterial street mobility issues, reliability performance measures, and addressing the agency challenges for FAST Act requirements. For over 30 years, TTI's urban mobility research efforts have developed and refined a comprehensive set of performance measures and the tools to measure and monitor mobility conditions in urban America. Since 1998, the study has been a pooled fund effort involving a combination of state departments of transportation (DOTs) (currently 15), FHWA and other sponsors from metropolitan planning organizations and Transport Canada. The analysis procedures and resulting performance measures have been used in multi modal performance measurement efforts by numerous state DOTs, metropolitan planning organizations (MPOs) and in other countries.

DDOT joined this project in 2020 for the current 2-year work plan and will evaluate its utility and the future work plans before committing further. This project is approved for 100% SPR-A funds. It is included here for consolidated pooled fund tracking, but does not involve research funds directly.

- **Manager**: Kelli Raboy, ITS Manager, Traffic Engineering & Safety Division; Ting Ma, Performance Manager, Performance Management Division

- **Lead Agency**: Texas DOT
- **Planned Completion**: Funds transferred by August 2021; project is ongoing through at least 2021 (updates in 2-year cycles).
- **FY2021 Contribution**: $25,000 in SPR-A funds

Project TPF-5(455)
Title: National Accessibility Evaluation Phase II Access Across America

This project has two main objectives. First, it will create a new, national Census block-level accessibility dataset that can be used by partners in local transportation system evaluation, performance management, planning, and research efforts. Second, it will produce and publish a series of annual reports describing accessibility to jobs by auto, transit, and biking in metropolitan areas across America. Accessibility Dataset

This is the second iteration of this pooled fund, with a new TPF number for the next 5-year period. DDOT has participated in this study since its inception in 2015. This project is approved for 100% SPR funds and therefore no District share is included for this project.

- **Manager**: Stephanie Dock, Research Program Administrator, State & Regional Planning Division
- **Lead Agency**: Minnesota DOT
- **Planned Completion**: Funds transferred by August 2021; project is ongoing through 2025.
- **FY2021 Contribution**: $36,000

Project TPF-1530
Title: Research Project Tracking System

Each state in the U.S. has a transportation research program. While these programs vary substantially in size, complexity, staffing level, and resource availability, there are certain needs that are generally common to all programs. One of these needs is a tracking system for active and completed research projects. The tracking system can be used for numerous functions, including (but not necessarily limited to) tracking of active projects, research implementation, work plan submissions and approvals, key project-related documents and deliverables, and reports. This study will develop common functional requirements, a software solution and maintenance of the software solution for a Research Program Tracking System to be used by multiple DOTs.

DDOT is joining Phase 1 of this study in 2021. Contributions to Phase 2, which will build the tracking system, will depend on the utility of the tool to DDOT. This project is approved for 100% SPR funds and therefore no District share is included for this project.

- **Manager**: Stephanie Dock, Research Program Administrator, State & Regional Planning Division
- **Lead Agency**: Kentucky Transportation Cabinet

- **Planned Completion**: Funds transferred by August 2021; future contributions will depend on outcomes from the first year of the study
- **FY2021 Contribution**: $3,500

04 Quick Response, Literature Reviews, & Pilot Support

Work Item Budget	Total Amount:	$85,000
	Federal Portion:	$68,000
	District Portion:	$17,000

Line Item Budget Details

Line Item	Description	Estimated Cost FY20	Prior Contributions	Total Cost Estimate
2020-041	Advisory Bicycle Lanes Evaluation (Phase 2)	$15,000	$10,850	$25,850
2021-041	Pilot Support	$50,000	$0	$50,000
2021-043	Projects TBD	$20,000	$0	$20,000

Funding Category Purpose & Objectives

The Research Program sets aside funds for quick response projects to respond to requests from upper management and literature review and market scan efforts that are too large to be conducted internally. These funds are not programmed in advance because quick response and literature review projects are by their nature uncertain at the time of work plan development. The use of these funds requires approval from DDOT leadership (PSD Associate Director, DDOT Chief of Staff, or DDOT Director). Project details will be added and numbered when (and if) projects be identified and approved.

The cost estimate for this project is based on the last several years of requests and known items that may be in the works. On average, requests have averaged $30,000-$35,000 per year, but expenditures in years the funds are used are typically higher.

Year	# of Projects	Expenditures	Notes
2015	1	$110,135	
2016	0	$0	Line item re-budgeted
2017	3	$49,600	
2018	0	$0	No work program for FY2018
2019	0	$0	$25,000 requested but not funded due to proximity to end of the program year and project timeline; $5,000 item discussed but not formally requested before year end
2020	1	$10,850	

Project 2020-041
Title: Advisory Bicycle Lane Evaluation (Phase 2)

In October 2019, the FHWA granted DDOT permission for a trial of the advisory bike lane pattern on five corridors in the Capitol Hill area of the District of Columbia. This experiment is aimed at determining the effectiveness of the new advisory bike lanes that are to be installed on five corridors in the Capitol Hill area in the District of Columbia. The experiment will consist of an evaluation process to observe bicyclists' and motorists' behavior along the subject streets before and after the application of the experimental devices. A survey to assess bicyclists' sense of safety along with motorists' understanding of the purpose of the advisory bike lanes will also be included in this experiment.

This continuation funds Phase 2 of the analysis will finish out this study.

- **Manager**: Will Handsfield, Bicycle Specialist, Planning & Sustainability Division
- **Work Conducted By**: Howard University
- **Expected Date of Issuance**: June 2021
- **Planned Completion**: September 2021 (3 month project)
- **Cost Estimate**: $15,000

Project 2021-041
Title: Pilot Support

DDOT has initiated a new intake process for potential partners (academic, private sector, and others) seeking to pilot, demonstrate, or test emerging transportation technologies in the District of Columbia. The program is meant to bring a more structured process for identifying, selecting, and implementing pilots and demonstrations. There has been good interest from a variety of potential partners. DDOT is now at a stage where we would be ready to move forward with some pilots, but staff are finding that in several cases, the existing regulatory structure does not cover these specific activities or requires a modification to the existing regulations. This project will assist the agency in developing a pilot policy and a draft rulemaking to implement that policy.

- **Manager**: Dan Emerine, Manager, Policy & Legislative Affairs
- **Work Conducted By**: Consultant TBD
- **Expected Date of Issuance**: January 2021
- **Planned Completion**: May 2021 (5 month project)
- **Cost Estimate**: $50,000

Project 2021-042
Title: TBD

Manager, timeline, entity to conduct the work, and tasks are defined as requests come in.

10 Research Projects

Work Item Budget		
	Total Amount:	$743,650
	Federal Portion:	$594,920
	District Portion:	$148,730
	Other Funds:	$0

Line Item Budget Details

Line Item	Description	Estimated Cost FY20	Prior Contributions	Total Cost Estimate
2021-101	Building Up Agency-Wide Automated Image Processing Capability to Inform Safety and Mobility	$100,000	$0	$100,000
2021-102	Turning Movements, Delays, and Percent Arrival on Green at 100 DC Interchanges with Crowd-Sourced Data	$257,750	$0	$257,750
2021-103	Identifying and Intervening with High-Risk Drivers	$175,000	$0	$175,000
2021-104	Tax Revenue and Telecommuting	$210,900	$0	$210,900
2020-101	Pedestrian and Cyclist Intersection Safety Sandbox	$36,229	$163,511	$199,740
2020-102	Full Evaluation of a Low-Income Transit Fare Pilot Program in DC	$0	$0	$0

Funding Category Objectives

Research projects are selected through the process described in the Research Manual. A call for projects is issued annually and projects are ranked by the Research Project Selection Committee (RPSC), a group comprised of the agency's senior leadership. There were 12 projects submitted and championed for FY2021 funding. Those projects were presented to and ranked by the RPSC on September 11, 2020. Four projects are proposed for funding this year. These projects will each be individually, separately obligated. There are also two projects continuing from prior years.

The complete project descriptions are included in Appendix B.

Project 2021-101
Title: Building Up Agency-Wide Automated Image Processing Capability to Inform Safety and Mobility

DDOT frequently uses camera footage to better understand traveler behavior (e.g., around parking, lane usage, turning movements, and collisions or near misses) and existing configuration and condition of the roadway and associated infrastructure. This footage provides insight into existing patterns or conditions

for future planning or design changes, provides insight into real-time conditions for operational decision making, and drives before and after analyses for assessing the impacts of a change in condition.

To date, much of the processing of this footage has been done manually, which often proves costly and inefficient, thereby limiting the degree to which DDOT is able to use camera footage. Recent advances in artificial intelligence and machine learning have the potential to speed up and improve processes for analyzing camera footage, but a consistent, agency-wide approach is needed to ensure quality of analysis, maximize utility across divisions, and minimize any duplication of effort.

This project will provide comprehensive recommendations on how DDOT can expand its use of camera footage via automated image processing to ensure all agency information needs are met. Results will directly identify actions and changes that DDOT can make to existing technology, policy, and processes to ensure quality of analysis, maximize utility across divisions, and minimize any duplication of effort. The project will benefit the District by enhancing DDOT's ability to understand traveler behavior and roadway conditions toward better planning, design, and operational decision-making.

- **Manager**: Kelli Raboy, ITS Manager, Transportation Operations & Safety Division; James Graham, GIS Manager, Information Technology Division
- **Work Conducted By**: Consultant (A&E Schedule)
- **Expected Date of Issuance**: January 2021
- **Planned Completion**: December 2021 (12 month project)
- **Cost Estimate**: $100,000

Project 2021-102
Title: Turning Movements, Delays, and Percent Arrival on Green at 100 DC Interchanges with Crowd-sourced Data

Traffic signals impact many aspects of safety and mobility—especially in urban areas. For this reason, many agencies have been adopting Automated Traffic Signal Performance Measures (ATSPM) to continuously monitor signals to ensure equitable mobility solutions. However, the costs to deploy ATSPM at intersections can be prohibitive due to the types of sensors and communication infrastructure that must be installed and maintained at each intersection. Furthermore, they don't provide all necessary functions that engineers need, and the size of the data coming out of each intersection can be expensive to manage. The result is that many agencies are unable to fully take advantage of the insights that ATSPM may provide to enhance their existing capabilities in managing signalized intersections.

The goal of this project is to leverage existing 3rd party data to deliver ATSPM-style capabilities to 100 signalized interchanges in DC and do so at a substantially reduced cost that would eventually be scalable to the entire city. The results will enable other cities to adopt a similar approach to signal operations and wide-scale deployments with minimal funding. This project will also scale the CATT Lab's validation methodology and apply it to intersections covered in this study with the support of DDOT.

- **Manager**: Wasim Raja, Associate Director, Traffic Engineering & Safety Division

- **Work Conducted By**: University
- **Expected Date of Issuance**: January 2021
- **Planned Completion**: April 2022 (16 month project)
- **Cost Estimate**: $257,750

Project 2021-103
Title: Identifying and Intervening with High-Risk Drivers

Research suggests that many dangerous drivers are simply not aware of: (1) the fact that they are driving unsafely; (2) the risk associated with their dangerous driving; and (3) how far out of the norm their dangerous driving is. Automated notifications have also been shown to increase desirable behavior and reduce undesirable behavior across many contexts, including driving. For example, in a study of teenage drivers, alerting both the teenagers and the parents of teenage drivers of risky behavior occurring in their cars can reduce risky driving. The District does something similar, by using Automated Traffic Enforcement (ATE) systems to enforce traffic safety and regulations for red light and speeding violations. ATE systems do this by automatically taking photographs of the rear of the vehicle and its license plate if the driver violates regulations, then sends a citation and fine to the registered vehicle owner's address. However, these are *reactive* measures towards reducing risky driving behavior. Our study proposes to build upon this system further by targeting proactive measures to risky drivers to reduce crashes.

DDOT and The Lab will collaborate to design the modeling and intervention for this project. There are two key components to the intervention:

1. analysis of data from the District's ATE systems and MPD crash data, to predict a driver's likelihood of being involved in a crash
2. proactive intervention(s) to reduce risky behavior for drivers likely to be involved in a crash

The Lab @ DC will complete the analysis (#1) with existing staff time and resources. DDOT will fund the costs associated with proactive interventions (#2).

- **Manager**: Linda Bailey, Vision Zero Director, Vision Zero Division
- **Work Conducted By**: The Lab @ DC
- **Expected Date of Issuance**: January 2021
- **Planned Completion**: December 2022 (24 month project)
- **Cost Estimate**: $175,000

Project 2021-104
Title: Tax Revenue and Telecommuting

According to the D.C. Tax Facts, the motor fuel tax in 2000 was reported to be $32.65 million dollars and was drastically decreased to $25.1 million dollars in 2017. Transportation infrastructure is costly to build

and even costlier to maintain; in 2017, *The Condition of the District's Roadways* reported that the actual expenditure on the District roadways was 4.5 times higher than the FY 2010-2014 average. Concurrently, the adoption of electric and hybrid vehicles and decreases in road trips due to the transition to telecommuting and eCommerce, especially with the onset of the COVID-19 pandemic, are significantly influencing transportation revenue generation from gasoline taxes. This will become a serious challenge for infrastructure asset management in the near future.

The main objective of this research is to investigate the most influential parameters and possible scenarios affecting the District's Highway Trust Fund revenues due to increased telecommuting and changes in commute mode in order to propose a multi-criteria decision-making model for transportation tax revenue generation.

- **Manager**: Lezlie Rupert, Manager, State and Regional Planning Division; Kyle Scott, Resource Allocation Manager, Resource Allocation Division
- **Work Conducted By**: University
- **Expected Date of Issuance**: January 2021
- **Planned Completion**: June 2022 (18 month project)
- **Cost Estimate**: $210,900

Continuing Research Projects

Project 2020-101
Title: Pedestrian and Cyclist Intersection Safety Sandbox

Intersection crossing is increasingly a challenge for distracted pedestrians, seniors, and individuals with disabilities (e.g., low vision or mobility issues). DC's Vision Zero Initiative seeks to reach zero fatalities and serious injuries to travelers of DC's transportation system, through more effective use of data, education, enforcement, and engineering. Part of both Vision Zero and DDOT's long-range transportation plan, MoveDC, is a commitment to increase pedestrian and cyclist safety at intersections.

As the Nation's Capital, DDOT receives numerous vendor pitches for emerging technology solutions. However, because of the nascent nature of these solutions, their potential benefit to the agency is often difficult to assess and, if deemed suitable, often difficult to champion toward implementation.

Toward a more strategic approach for testing applications of innovative solutions for Vision Zero, DDOT intends to implement one or more pilot or demonstration projects that use emerging technology solutions to improve pedestrian and/or cyclist safety in intersections. In technology development, the term "sandbox" is used to refer to a testing environment that allows for safe testing of new software or code before implementation in a program or serivce. Borrowing from this idea, this project will

designate a "sandbox" of a single intersection or corridor within the District to be used to safely pilot new technologies

This project will implement the sandbox with several emerging solutions and evaluate the outcomes. It is expected that many of the solutions will still be in research and development phases and that this project can help to shape those products while also providing valuable lessons learned for DDOT staff.

- **Manager**: Kelli Raboy, ITS Manager, Transportation Operations & Safety Division
- **Work Conducted By**: Consultant (A&E Schedule)
- **Expected Date of Issuance**: November 2020 (as soon as additional funds obligate)
- **Planned Completion**: March 2022 (18 month project)
- **Cost Estimate**: $36,229 in FY2021 funding ($202,189 for entire FAP, including IDCR and labor)

Project 2020-102
Title: Full Evaluation of a Low-Income Transit Fare Pilot Program in DC

Low-income households are the most likely to be burdened by the costs of using public transit, the most likely to forego using transit due to cost, and the least likely to have alternative travel options. The cost burden of transit has a number of possible negative effects on low-income Washingtonians, including inhibiting their ability to get and maintain employment, use social services, obtain healthcare, and complete educational programs. Preliminary results from a low-income fare pilot in Boston showed a 30% boost in transit use by low-income households, including trips for health-care/social services visits. In addition, a 2011 experiment in DC found that even small transit subsidies offered to the unemployed increased job search activity by 19%, especially among those living far from employment opportunities.

To learn whether and to what extent cost is a key barrier to transit equity, the DC Department of Transportation (DDOT) is partnering with The Lab @ DC, WMATA, the Department of Human Services (DHS), and the World Bank to conduct a randomized evaluation of a fully and partially subsidized Metro transit program. WMATA will create a discounted fare product that could be added to a SmarTrip card for eligible low-income individuals. DHS has committed to enroll participants from public assistance programs that already verify income and distribute income-based benefits as part of their standard business process.

In the study, participants will be randomly assigned to one of three conditions: no transit subsidy, a partially subsidized fare, and a fully subsidized fare, i.e. free unlimited trips. The project will rely partly on administrative data, which will capture the high-level impacts on the number of trips taken, jobs applied to, job trainings completed, and employment status. The acquisition and analysis of this data will be done through The Lab @ DC, World Bank, WMATA, and the grant from World Bank Abdul Latif Jameel Poverty Action Lab (JPAL) North America without funds from DDOT.

NOTE: This project is still included in the work program, but due to uncertainty on the timing of this project no funding is currently allocated to the project. This project requires that transit service be

operating near normal capacity, that people are regularly using the system for work and other trips, and that the local funding becomes available. Funding will be revisited should the project be ready to proceed in FY2021.

- **Manager**: Faye Dastgheib, Senior Policy Specialist, Policy and Legislative Affairs Division
- **Work Conducted By**: The Lab @ DC (Executive Office of the Mayor)
- **Expected Date of Issuance**: TBD – depends on status of transit system, stay-at-home orders, and funding availability (local funds are currently unavailable)
- **Planned Completion**: TBD (18 month project)
- **Estimated Cost**: $1,196,786 ($355,532 from SPR Part B funds). Other funding sources: local funds through WMATA; World Bank Abdul Latif Jameel Poverty Action Lab

Appendix A. Regulatory Compliance Checklist

REGULATION REQUIREMENT	23 CFR 420 Section	DDOT Compliance
The Program must be implemented in compliance with its approved work program.	117, 205	x
Annual approval of State DOT Research and Development Work Program.	111, 115, 209	x
Documentation that describes the State DOT's management process and the procedures for selecting and implementing RD&T activities must be developed by the State DOT and submitted to the FHWA Division office for approval. Significant changes in the management process must be submitted by the State DOT to the FHWA for approval.	115, 209	Updated and in review with FHWA
Periodic reviews of the State DOT's Management Process of the RD&T.	209	x
The State DOT's RD&T work program must, as a minimum, consist of a description of RD&T activities to be accomplished during the program period, estimated costs for each eligible activity, and a description of any cooperative activities including the State DOT's participation in any transportation pooled fund studies and the NCHRP. The State DOT's work program should include a list of the major items with a cost estimate for each item. The work program should also include any study funded under a previous work program until final report has been completed for the study.	207	x
The State DOT's RD&T work program must include financial summaries showing the funding levels and share (Federal, State, and other sources) for RD&T activities for the program year.	207	x
The State must use an interactive process for identification and prioritization of RD&T activities for inclusion in an RD&T work program.	209 (a)(1)	x
The State must use all FHWA planning and research funds set aside for RD&T activities to the maximum extent possible.	209 (a)(2)	x
The State must have procedures for tracking program activities, schedule, accomplishments, and fiscal commitments	209 (a)(3)	x
The State must use support and use of the TRID database for program development, reporting, and input of the final report information.	209 (a)(4)	x
The State must have procedures to determine the effectiveness of the State DOT's management process in implementing the RD&T program, to determine the utilization of the State DOT's RD&T outputs, and to facilitate peer exchanges of its RD&T Program on a periodic basis	209 (a)(5)	x
The State must have procedures for documenting RD&T activities through the preparation of final reports. As a minimum the documentation must include the data collected, analyses performed, conclusions, and recommendation. The State DOT must actively implement appropriate research findings and should document benefits.	209 (a)(6)	x
The State must participate in peer exchanges of its RD&T management process and other State DOTs' programs on a periodic basis. Note: FHWA has guidance defining "period" as at least once every 5 years for a minimum of 2-3 days.	209 (a)(7)	Planned for December 2020

REGULATION REQUIREMENT	23 CFR 420 Section	DDOT Compliance
The State DOT must include a certification that it is in full compliance with the requirements of this subpart in each RD&T work program. Note: the language to be used for this certification is specified in the regulation.	209	x
Suitable reports that document the results of activities performed with FHWA planning and research funds must be prepared by the State DOT or subrecipient and submitted for approval by the FHWA Division Administrator prior to publication. The FHWA Division Administrator may waive this requirement for prior approval.	117 (e)	x
The FHWA's approval of reports constitutes acceptance of such reports as evidence of work performed but does not imply endorsement of a report's findings or recommendations. Reports prepared for FHWA-funded work must include appropriate credit references and disclaimer statements.	117 (e)	x
The State DOT must administer the RD&T program consistent with their overall efforts to implement section 1001(b) of The Transportation Equity Act for the 21st Century and 49 CFR part 26 regarding disadvantaged business enterprises.	121 (c)	x
The nondiscrimination provisions of 23 CFR 200 etc. with respect to Title VI of the Civil Rights Act of 1964 and the Civil Rights Restoration Act of 1987 apply to all programs and activities of recipients, subrecipients, and contractors receiving FHWA research funds, whether or not those programs or activities are federally funded.	121 (h)	x
Procedures for the procurement of property and services with FHWA research funds must be in accordance with 49 CFR and/or other applicable regulations.	121 (j)	x
(A) Costs are eligible for FHWA participation provided that the costs: 1) are for work performed for activities eligible under the Section of title 23 applicable to the class of funds, 2) are verifiable from the State DOT's or the subrecipient's records, 3) are necessary and reasonable for the proper and efficient to accomplish of project objectives and meet the other criteria for allowable costs in the applicable cost principles, 4) are included in the approved budget or amendments thereto, 5) were not incurred prior to FHWA authorization, and (B) indirect costs are allowable if supported by a cost allocation plan and indirect cost proposal prepared, submitted, and approved as required	113	x
The State DOT must submit performance and expenditure reports, including a report from each subrecipient that contain as a minimum: (i) Comparison of actual performance with established goals; (ii) Progress in meeting schedules; (iii) Status of expenditures in a format compatible with the work program, including a comparison of budgeted (approved) amounts and actual costs incurred; (iv) cost overruns or underfunds; (v) approved work program revisions; and (vi) other pertinent supporting data.	117 (b)	x

Appendix B: Project Descriptions

Building Up Agency-Wide Automated Image Processing Capability to Inform Safety and Mobility (2021-101)

ISSUE

DDOT frequently uses camera footage to better understand traveler behavior (e.g., around parking, lane usage, turning movements, and collisions or near misses) and existing configuration and condition of the roadway and associated infrastructure. This footage provides insight into existing patterns or conditions for future planning or design changes, provides insight into real-time conditions for operational decision making, and drives before and after analyses for assessing the impacts of a change in condition.

To date, much of the processing of this footage has been done manually, which often proves costly and inefficient, thereby limiting the degree to which DDOT is able to use camera footage. Recent advances in artificial intelligence and machine learning have the potential to speed up and improve processes for analyzing camera footage, but a consistent, agency-wide approach is needed to ensure quality of analysis, maximize utility across divisions, and minimize any duplication of effort.

BACKGROUND AND EXISTING KNOWLEDGE

There have been a number of efforts to bring machine learning to image processing for transportation purposes at DDOT and in the industry more broadly.

- Sensity, now owned by Verizon, installed cameras in the PA2040 area and the parkDC Penn Quarter/Chinatown area that did image processing to detect when parking spaces are occupied. The processing was done "on the edge" (as part of a processors attached to the camera), rather than transmitting the images back. The technology requires its own cameras that are integrated into streetlights.
- George Washington University, as part of the GigabitDCx competition run by OCTO, developed a platform to which anyone could submit a timelapse or full motion video and have it processed to do vehicle, bike, and pedestrian counts. GWU has developed this technology further, but the crowdsourced platform has not advanced further.
- Conduent has used machine learning to process data from our time lapse cameras to better understanding parking patterns
- Microsoft and Esri engaged DDOT to use existing traffic cameras to track vehicular counts and near misses. Work with Esri is ongoing but did not continue with Microsoft due to constraints around camera movements.
- Several other vendors (e.g., Miovision) have reached out with possible applications, but these have not gone beyond initial pitches or exploration

Other areas are also in development. The Massachusetts Department of Transportation recently completed a research project that relied on mobile LiDAR and automated processing to detect pedestrian and ADA features along state highways.[1]

SCOPE OF WORK

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[1] Ai, Chengbo and Qing Hou, "Improving Pedestrian Infratructure Inventory in Massachusetts Using Mobile LiDAR" September 2019, https://www.mass.gov/doc/improving-pedestrian-infrastructure-inventory-in-massachusetts-using-mobile-lidar-1/download

The primary objective of this project is to build up DDOT's automated image processing capability. This will be achieved through a series of tasks:

- Assessment of use cases and needs via internal stakeholder outreach
- Market research on available tools and technologies, including use cases, implementations to date, required supportive technologies and processes, and validation and verification
- Identification of existing gaps in supportive technologies and processes (e.g., installation and data storage)
- Comprehensive recommendations on next steps for standing up a consolidated program that can effectively and efficiently support need for automated image processing agency wide.

Potential use cases include, but are not limited to: vehicle trajectories, object and count detection, near misses Near misses, trajectories, object and count detection parking occupancy detection; vehicle, freight, cyclist, pedestrian counts and turning movements; collision and near miss detection; pavement and sidewalk condition; lane and signal configuration; sign and pole inventory.

POTENTIAL BENEFITS AND IMPLEMENTATION

This project will provide comprehensive recommendations on how DDOT can expand its use of camera footage via automated image processing to ensure all agency information needs are met. Results will directly identify actions and changes that DDOT can make to existing technology, policy, and processes to ensure quality of analysis, maximize utility across divisions, and minimize any duplication of effort. The project will benefit the District by enhancing DDOT's ability to understand traveler behavior and roadway conditions toward better planning, design, and operational decision-making.

TIME/COST ESTIMATE

12 months; $100,000

Turning Movements, Delays, and Percent Arrival on Green at 100 DC Interchanges with Crowd-sourced Data (2021-102)

ISSUE

DDOT is the lead agency implementing Mayor Bowser's Vision Zero transportation safety initiative. Traffic signals impact many aspects of safety and mobility—especially in urban areas. For this reason, many agencies have been adopting Automated Traffic Signal Performance Measures (ATSPM) to continuously monitor signals to ensure equitable mobility solutions. However, the costs to deploy ATSPM at intersections can be prohibitive due to the types of sensors and communication infrastructure that must be installed and maintained at each intersection. Furthermore, they don't provide all necessary functions that engineers need, and the size of the data coming out of each intersection can be expensive to manage. The result is that many agencies are unable to fully take advantage of the insights that ATSPM may provide to enhance their existing capabilities in managing signalized intersections.

BACKGROUND AND EXISTING KNOWLEDGE

Automated Traffic Signal Performance Measures (ATSPM) are a suite of performance measures, data collection, and other related analysis tools that support the management of traffic signals. This revolutionary method of managing signals is widely deployed in both Utah[2] and Georgia[3], and is gaining

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[2] https://ops.fhwa.dot.gov/publications/fhwahop18048/index.htm
[3] https://ops.fhwa.dot.gov/publications/fhwahop18050/index.htm

popularity around the country because of their ability to provide actionable insights into the performance of a signalized intersection. However, the costs to deploy ATSPM at intersections can be prohibitive due to the types of sensors and communication infrastructure that must be installed and maintained at each intersection. Often ATSPM systems do not provide all necessary functions that engineers need, and the size of the data coming out of each intersection can be expensive to manage. There is a cheaper alternative that can leverage speed/travel time and location data sourced from widely deployed connected vehicles in a way that mimics many of the ATSPM metrics, but without the need to deploy, operate, and maintain any roadside infrastructure or communications equipment.

The CATT Lab, along with Wayne State University researchers, have been exploring the use of the high-resolution trajectory data to support ATSPM analysis in Detroit, Michigan. The initial results shown in Figure 1 suggest that crowd-sourced data can accurately represent the turning movement percentages. This initial analysis not only shows the potential of this data for ATSPM applications but has established a framework for validating results at any study location.

The goal of this project is to leverage existing 3rd party data to deliver ATSPM-style capabilities to 100 signalized interchanges in DC and do so at a substantially reduced cost that would eventually be scalable to the entire city. The results will enable other cities to adopt a similar approach to signal operations and wide-scale deployments with minimal funding. This project will also scale the CATT Lab's validation methodology and apply it to intersections covered in this study with the support of DDOT.
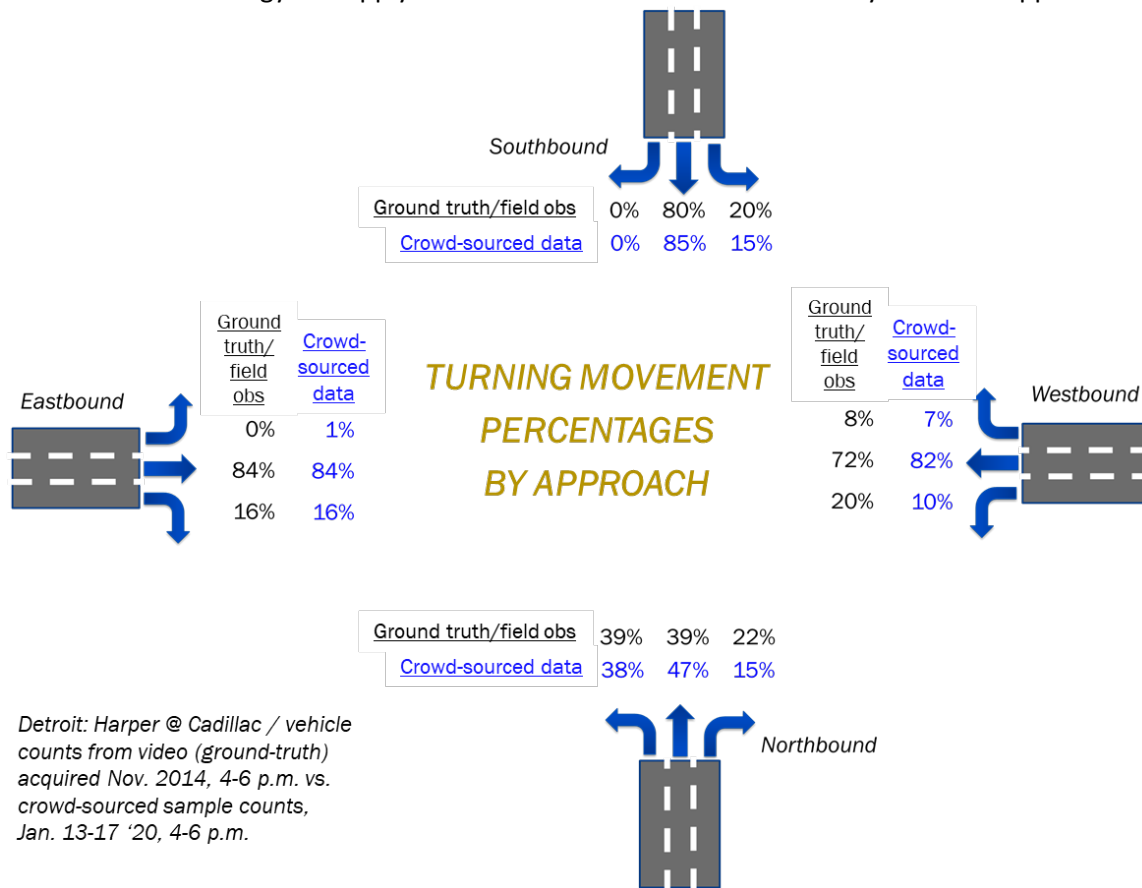

Figure 1: Sample of initial turning movement percentage validation analysis in Detroit, Michigan

SCOPE OF WORK

The objective of this study is to develop and validate an online intersection analysis tool based on high-resolution vehicle trajectory data at 100 target intersections. The envisioned output will allow users to evaluate the average travel times for each allowable turning movement by hour of day as well as histograms of travel times for each turning movement. Users can also use the output to rank the performance of all turning movements in the analysis area. Percent arrival on green will also be provided.

To accomplish these objectives, the project will be guided by the following tasks:

Task 1 - Identify target intersections: CATT Lab will work with DDOT to identify the 100 intersections to include in this study. For each, data quality checks will be performed to ensure the proposed methods and metrics are supported by existing 3rd party data.

Task 2 - Develop and deploy the web-based tool: This task will tie together the data feeds, methodology, and proposed user interfaces to create the formal online Signal Analysis Tool.

Task 3 - Validate results using ground truth data collected by DDOT: CATT Lab will work with DDOT to validate the metrics by using ground truth data from prior or ongoing DDOT signal studies. The strategy to re-use prior studies alleviates the need to collect additional data, allowing resources to be concentrated on the development of the tool.

POTENTIAL BENEFITS AND IMPLEMENTATION

The signal performance outputs from the proposed tool can be used to:

1. Calculate turning movement percentages
2. Measure travel times and delay for each turning movement
3. Analyze the percent of arrivals on green
4. Estimate the number of stops on an intersection approach

Such results can be used to identify or rank poor performing signalized intersections and provide insights on potential solutions such as signal re-timing or enhanced control logic. The tool also provides automatically generated data visualizations that can be used to communicate findings with a broad audience ranging from the general public to traffic experts. Once fully tested and proven, the system could theoretically be scaled to cover every intersection in the District. Doing so would result in significant savings over traditional signal data collection and analysis methods while enhancing DDOT's ability to continuously and proactively monitor the performance of their signals.

TIME/COST ESTIMATE
16 months / $245,000

Identifying and Intervening with High-Risk Drivers (2021-103)

ISSUE

Every year there are dozens of recorded driving-related fatalities, thousands of traffic crashes, and hundreds of thousands of driving violations (speeding and dangerous driving) in the District. With 27 traffic fatalities in 2019 and 209 crashes resulting in injuries to date in 2020, we are far from the District's goals of achieving zero traffic fatalities by 2024.

DDOT, DMV, MPD, and The Lab @ DC in OCA are working together on this project to identify drivers at high risk of being involved in a serious crash and to test proactive interventions to these high-risk drivers.

BACKGROUND AND EXISTING KNOWLEDGE

A joint study (not yet published) conducted by the New York City Department of Transportation (NYC DOT) and the University of Chicago (UChicago) analyzing traffic violations and crash data found that those with repeat speeding and red-light violations were more likely to have subsequent crashes. Researchers from this study found that repeat offenders are 30% more likely to be involved in a serious traffic crash.[4] Another (internal and not publicly available) driver behavior study conducted by the University of Chicago for the Chicago Department of Transportation found that previous citations and crashes can predict subsequent crash risk. Their preliminary results found that drivers with at least two tickets in the past three months and at least three tickets in the past 2.5 years are 3 times more likely to be involved in a crash in the following year. A different study found that a small share of drivers (5%) were responsible for 35% of crashes in Louisiana (Das et al, 2015).

Research suggests that many dangerous drivers are simply not aware of: (1) the fact that they are driving unsafely; (2) the risk associated with their dangerous driving; and (3) how far out of the norm their dangerous driving is.[5] Automated notifications have also been shown to increase desirable behavior and reduce undesirable behavior across many contexts, including driving. For example, in a study of teenage drivers, alerting both the teenagers and the parents of teenage drivers of risky behavior occurring in their cars can reduce risky driving.[6] The District does something similar, by using Automated Traffic Enforcement (ATE) systems to enforce traffic safety and regulations for red light and speeding violations. ATE systems do this by automatically taking photographs of the rear of the vehicle and its license plate if the driver violates regulations, then sends a citation and fine to the registered vehicle owner's address. However, these are *reactive* measures towards reducing risky driving behavior. Our study proposes to build upon this system further by targeting proactive measures to risky drivers to reduce crashes.

SCOPE OF WORK

DDOT and The Lab will collaborate to design the modeling and intervention for this project. There are two key components to the intervention:

1. analysis of data from the District's ATE systems and MPD crash data, to predict a driver's likelihood of being involved in a crash

2. proactive intervention(s) to reduce risky behavior for drivers likely to be involved in a crash

The Lab @ DC will complete the analysis (#1) with existing staff time and resources. This proposal is intended to fund the costs associated with proactive interventions (#2).

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[4] NYC DOT study has not been made public yet.

[5] Leonard Evans, Traffic Safety (2004).

[6] Simons-Morton et al, *The Effect on Teenage Risky Driving of Feedback From a Safety Monitoring System: A Randomized Controlled Trial.* Journal of Adolescent Health 53 (2013).

Predictive Model

Our model will use regression and machine learning methods to predict the likelihood that a driver will be involved in a crash in the next year. The goals of our model are to use the model predictors (e.g., features describing the people involved in a crash and/or receive a citation, features of the vehicles involved, locations, weather conditions, time of day, season) to (1) develop risk levels of being involved in a crash and (2) to develop "profiles" of risky drivers to target our proactive interventions. We also plan to evaluate whether the impact of an intervention varies with a driver's predicted probabilities of being involved in a crash.

Interventions

In partnership with The Lab @ DC, DDOT will use the model's predictions to target proactive interventions to risky drivers. While we do not know yet what intervention will be the most effective in changing drivers' behaviors, we'll bring a behavioral and evidence lens to the messaging, for instance, some examples could be:

- **Loss-aversion.** "Your household is at risk of losing your vehicle -- and very possibly a life -- due to risky driving. The [make and model] has been cited __ times for dangerous driving, putting you at risk of losing your car insurance and your car, and placing the driver at high risk of an accident. Don't lose your family member or your car -- determine who is driving dangerously and remind them to drive safely."
- **Social norms & Pluralistic ignorance.** "The vast majority of drivers are safe, but someone in your household is driving very dangerously. Your vehicle is in the top __% for riskiest driving in the District. Save the lives of your family members and others on the road. " [some evidence-based advice]
- **Social Influence.** "You can reduce the risk of [losing your vehicle / being in an accident] by making sure that everyone in your household knows the rules of the road, including speed limits and how to change lanes safely."
- **Identity-affirmation.** "Your vehicle is in the top __% for riskiest driving in the District. As the vehicle owner, you control what happens next. You are uniquely capable of reducing driving-related risks in your vehicle. Take action! ... "

We will prioritize at least one such intervention for rigorous testing based on feedback from experts, user-testing, and feasibility of random assignment.

Experimental Design

The evaluation design for this project will depend, in part, on the intervention(s) designed. Broadly, we intend to use a randomized controlled trial to evaluate the impact of an intervention on the number of speeding and red-light violations in the District.

POTENTIAL BENEFITS AND IMPLEMENTATION

Outcomes: Our primary outcome of interest is the level of traffic violation levels, measured by the number of drivers with repeat red-light and speeding violations. We expect to see fewer red-light and speeding infractions for drivers in the treatment group, i.e. those receiving the intervention (notification that they are a risky driver) compared to their baseline level compared to those who do not receive the intervention.

How Results could be Implemented: If we see statistically significant results after evaluating the effectiveness of the intervention, The Lab will work with DDOT to deploy the model so that DDOT can use the predictions and send notifications to all drivers who are predicted to be at high risk.

Benefits to the District: In addition to helping the District reduce the level of traffic injuries and fatalities by encouraging safer driving behaviors, this project would benefit the District by moving us closer to our Vision Zero goals of reaching zero traffic fatalities by 2024.

TIME/COST ESTIMATE
24 months; $175,000

Building Up Agency-Wide Automated Image Processing Capability to Inform Safety and Mobility (2021-101)

ISSUE
The District of Columbia has 1,057 miles of federal and local roadways with 21.6% in poor and 25.3% in fair conditions, and 244 bridges of which 12% are reported as structurally deficient. Concurrently, the adoption of electric and hybrid vehicles and decreases in road trips due to the transition to telecommuting and eCommerce, especially with the onset of the COVID-19 pandemic, are significantly influencing transportation revenue generation from gasoline taxes. This will become a serious challenge for infrastructure asset management in the near future.

BACKGROUND AND EXISTING KNOWLEDGE
According to the D.C. Tax Facts, the motor fuel tax in 2000 was reported to be $32.65 million dollars and was drastically decreased to $25.1 million dollars in 2017. Transportation infrastructure is costly to build and even costlier to maintain; in 2010 the federal government spent approximately $4 billion was spent on the construction of new highways and bridges while $19 billion was spent on maintenance of existing highways and bridges. In 2017, *The Condition of the District's Roadways* reported that the actual expenditure on the District roadways was 4.5 times higher than the FY 2010-2014 average.

SCOPE OF WORK

The main objective of this research is to investigate the most influential parameters and possible scenarios affecting the District's Highway Trust Fund revenues due to increased telecommuting and changes in commute mode in order to propose a multi-criteria decision-making model for transportation tax revenue generation. Within the research plan, several activities are embedded into the six (6) proposed tasks, resulting in the development of a tax revenue generation model. The six proposed tasks are:

Task 1: Literature Review
In this task a comprehensive literature review will be conducted on the effects of transitioning to telecommuting and related factors such as fuel efficiency, electric and hybrid vehicles, fuel prices, and eCommerce on transportation tax revenue generation. District transportation expenditures in the last 20 years will also be studied.

Task 2: Analyze Current Transportation Tax Revenue Models
DC's transportation expenses include the costs required to operate and maintain the current transportation system, and to expand services and infrastructure as needed. Due to inflation, real revenue value has decreased. In addition, higher vehicle fuel efficiency has further worsened revenue generation (Puro, 2013). To address the deficiency of the current funding scheme, this task will analyze the current transportation tax revenue model and the variables affecting it in the District. See Figure 1.
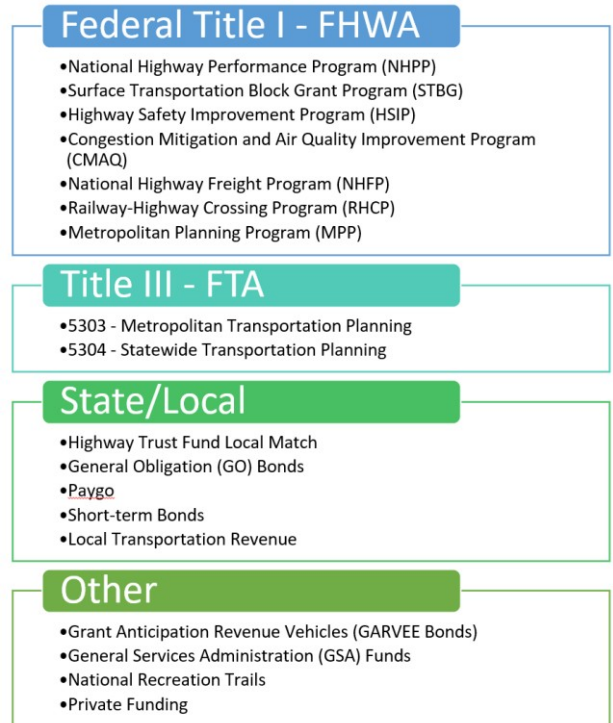
Federal Title I - FHWA
- National Highway Performance Program (NHPP)
- Surface Transportation Block Grant Program (STBG)
- Highway Safety Improvement Program (HSIP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- National Highway Freight Program (NHFP)
- Railway-Highway Crossing Program (RHCP)
- Metropolitan Planning Program (MPP)

Title III - FTA
- 5303 - Metropolitan Transportation Planning
- 5304 - Statewide Transportation Planning

State/Local
- Highway Trust Fund Local Match
- General Obligation (GO) Bonds
- Paygo
- Short-term Bonds
- Local Transportation Revenue

Other
- Grant Anticipation Revenue Vehicles (GARVEE Bonds)
- General Services Administration (GSA) Funds
- National Recreation Trails
- Private Funding

Figure 1. DDOT Funding Sources

Task 3: Investigate the Impact of Telecommuting on Transportation Tax Revenue and Expenditures
The number of remote workers nationally has increased by 159% since 2005 (USDOT, 2017). Although previous reports estimated that only a third of jobs can be done entirely from home, up to half of American workers are now working from home due to the COVID-19 pandemic. This has more than doubled the portion of people who worked from home in 2017-2018 (Guyot & Sawhill, 2020). In this task, the impact of the rapid transition to telecommuting on daily travel patterns and consequently on District transportation tax revenue generation will be investigated.

Task 4: Perform a Comprehensive Survey Study on the Transition from Commuting to Telecommuting
According to an EV Adoption (2019) report, the US electric vehicle market share will increase from 3.04% in 2020 to 17.65% in 2028. Moreover, US ecommerce sales have increased by 136.7% since 2008 and are expected to grow by 30% by 2022. A comprehensive questionnaire will be designed and widely distributed to a large group of participants (+200) in order to collect data related to willingness to telecommute rather than travel for job and leisure purposes, purchasing a hybrid/electric vehicle, online shopping, as well as willingness to pay taxes for state and federal services provided.

Task 5: Conduct Sensitivity Analyses

In addition to recent rapid transitions to telecommuting, other factors influencing the transportation tax revenue generation, will be analyzed, see Figure 2, to develop projection models of future revenue. After identifying the main influential factors, a sensitivity analysis will be conducted for each variable to estimate its effects on revenues. Given the high uncertainty about most of these parameters, the sensitivity analysis will focus on realistically estimating transportation tax revenue generation. Subsequently, a parametric study will be conducted to analyze the correlations and interrelation between the most influential factors and transportation tax revenue generation.

Task 6: Analyze Data, Develop Model, and Evaluate Alternatives

Using the data generated from Task 3 through Task 5, along with the data extracted from current sources in Task 2, a model will be developed to predict future transportation tax revenue generation in the next 10 years and propose alternative strategies for the District to bridge the gap between the revenue lost and expenditures. These strategies will be the result of the sensitivity analysis and a series of what-if analyses of possible future scenarios to draw conclusions regarding models and effective policies for funding future transportation needs.

Figure 2. Main components of transportation tax revenue generation

Task 7: Prepare Reports Including Recommendations for Implementation

An interim report to DDOT will be prepared after nine (9) months of project work which will document progress on Tasks 1-4. The final report after 18 (18) months of project work will document the methods used and findings obtained in this project. It will include recommendations for implementing the products of this study, including specific alternatives for matching transportation revenues to the needs of transportation agencies.

POTENTIAL BENEFITS AND IMPLEMENTATION

It is expected that by identifying the main variables and analyzing the possible scenarios affecting the transportation tax revenue due to the transition to telecommuting, as well as conducting the sensitivity and parametric analyses, the proposed model will aid policy makers in predicting transportation tax revenues and making decisions on alternatives for bridging the revenue gap.

TIME/COST ESTIMATE

18 months; $198,150

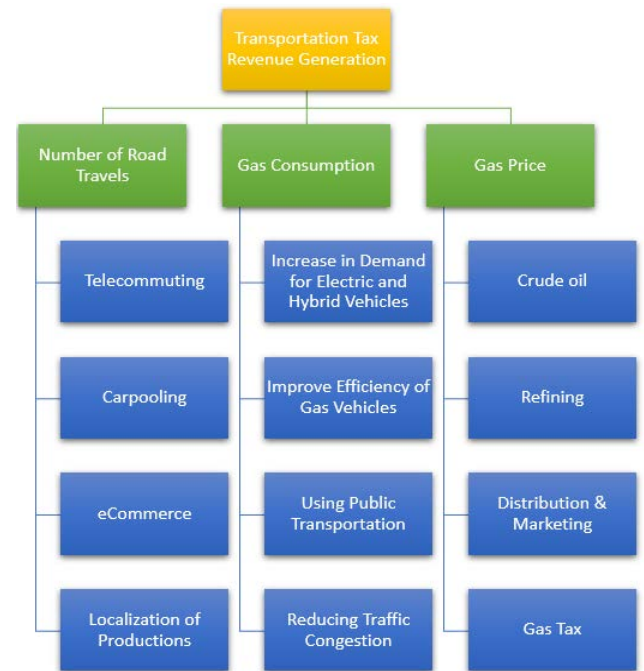## Pedestrian and Cyclist Intersection Safety Sandbox (2020-101)

ISSUE

Intersection crossing is increasingly a challenge for distracted pedestrians, seniors, and individuals with disabilities (e.g., low vision or mobility issues). Nationally, 5,376 pedestrians died in crashes in 2015, a 9.4% increase from the previous year. DC's Vision Zero Initiative seeks to reach zero fatalities and serious injuries to travelers of DC's transportation system, through more effective use of data, education, enforcement, and engineering. Part of both Vision Zero and DDOT's long-range transportation plan, MoveDC, is a commitment to increase pedestrian and cyclist safety at intersections.

As the Nation's Capital, DDOT receives numerous vendor pitches for emerging technology solutions. However, because of the nascent nature of these solutions, their potential benefit to the agency is often difficult to assess and, if deemed suitable, often difficult to champion toward implementation.

Given these issues, a more strategic approach for testing applications of innovative solutions for Vision Zero is needed.

BACKGROUND AND EXISTING KNOWLEDGE

A preliminary version of this proposal was submitted and accepted during the 2017 Call for Research Projects process, but ultimately did not move forward due to lack of funding. At that time the technical team worked extensively with the research team to expand and refine the scope, review literature on existing technologies, and develop an RFI and RFQ for solicitation. These materials have been shared with members of the Sustainable Transportation Branch, the Associate Director for Transportation Operations and Safety, and the former lead on Vision Zero.

SCOPE OF WORK

The research is intended to implement a sandbox for one or more pilot or demonstration projects that use emerging technology solutions to improve pedestrian and/or cyclist safety in intersections. The sandbox would encompass a single intersection or corridor within the District. Envisioned solutions include:

- Technology that enhances DDOT's situational awareness of intersection activity to inform safety improvements
- Technology that provides auditory or visual alerts for pedestrians, cyclists, and/or drivers approaching crosswalks based on real-time activity in the intersection

The research would fund a consultant to facilitate the program management and evaluation of this sandbox project. The primary tasks for the consultant would be to assist DDOT in finding an appropriate mix of vendors, facilitate pilots and provide incentive funds to help cover vendor pilot costs (using funds from project budget), and evaluate the pilots.

More detailed scopes of work for both the 1) program management and evaluation support and 2) the RFI intended to identify vendors interested in participating in the sandbox have been provided as separate attachments to this submission.

POTENTIAL BENEFITS AND IMPLEMENTATION

The research would result in implementation and evaluation of one or more pilot or demonstrations of emerging technology for pedestrian and/or cyclist safety in intersections. The implementation and evaluation would further provide insight into the feasibility and usability of these technologies, thereby enabling DDOT to make more informed decisions on whether to pursue a full-scale implementation. Ultimately, this research would improve safety outcomes for pedestrians and cyclists in the District.

Additionally, as this would be the first instance of DDOT's use of a sandbox approach for procurement and evaluation of emerging technology solutions, it could be used as a model for future sandbox projects to address a variety of DDOT needs.

TIME/COST ESTIMATE
18 months; $150,000

Full Evaluation of a Low-Income Transit Fare Pilot Program In DC (2020-102)

ISSUE
Low-income households are the most likely to be burdened by the costs of using public transit, the most likely to forego using transit due to cost, and the least likely to have alternative travel options. WMATA's ridership data shows us that:
- Over 65% of highest income rail customers receive a transit subsidy through employer-sponsored programs, compared to only 10% of DC's lowest income rail customers (Nelson et al. 2007).
- Low-income riders are more likely to spend more per month by purchasing individual rides rather than paying upfront for a discounted monthly pass.
- Low-income riders comprise 52% percent of DC's bus ridership, compared with 13% of rail ridership, which is likely due to the higher cost of rail trips, among other factors.

BACKGROUND
The cost burden of transit has a number of possible negative effects on low-income Washingtonians, including inhibiting their ability to get and maintain employment, use social services, obtain healthcare, and complete educational programs. Preliminary results from a low-income fare pilot in Boston show that low-income households receiving a discounted fare take about 30% more trips, including more health care/social service trips (Rosenblum et al. 2019). In addition, a 2011 experiment in DC found that even small transit subsidies offered to the unemployed increased job search activity by 19%, especially among those living far from employment opportunities (Phillips 2014).

These examples show initial changes in transit trips and job search, but there exists little evidence on the broader effects of subsidized fares on other measures of welfare and the implications for poverty and inequality in the US generally or DC in particular. Nationally, many jurisdictions are adopting transit fare subsidies for low-income riders but are doing so without first piloting them for feasibility, impact, and cost-effectiveness. Though some government programs and nonprofits provide transit subsidies, there is no universally-available fare product for low-income residents in DC.

SCOPE OF WORK
Objective: To learn whether and to what extent cost is a key barrier to transit equity, the DC Department of Transportation (DDOT) is partnering with The Lab @ DC, WMATA, the Department of Human Services (DHS), and the World Bank to conduct a randomized evaluation of a fully and partially subsidized Metro transit program. Can a subsidized fare program for low-income residents increase (1) mobility through greater usage of public transit and (2) other measures of social and economic well-being?

Research approach: This grant will allow us to expand the scope and improve the quality of data collected in an evaluation that is already in the planning stages. In the study, participants will be randomly assigned to one of three conditions: no transit subsidy, a partially subsidized fare, and a fully subsidized fare, i.e. free unlimited trips.

WMATA will create a discounted fare product that could be added to a SmarTrip card for eligible low-income individuals. DHS has committed to enroll participants from public assistance programs that already verify income and distribute income-based benefits as part of their standard business process. The project will rely partly on administrative data, which will capture the high-level impacts on the number of trips taken, jobs applied to, and job trainings completed, and employment status. The acquisition and analysis of this data will be done through The Lab @ DC, World Bank, WMATA, and the grant from JPAL North America without funds from this grant.

This grant will support this rigorous evaluation through (1) primary data collection on mobility and well-being outcomes and (2) data quality assurance for SmarTrip administrative data.
1. The primary data collection will provide vital data on outcomes not captured accurately or entirely by administrative data, allowing us to examine the effect of additional trips have on the quality of life of participants.
2. The accuracy of our administrative data relies on participants using the SmarTrip card registered to them in the study. To incentivize participants to keep and continue using those cards, we plan to regularly deposit a small amount of value onto the cards.

POTENTIAL BENEFITS AND IMPLEMENTATION
Outcomes: Our primary outcome of interest is mobility, measured by number of trips. We will also look at changes in trip length, total travel time, average travel time per trip, number of transfers, and mode used to explore the kinds of tradeoffs people are making to cost, travel time, and trip efficiency. In addition to mobility, we want to understand what else is affected when transit trips become less expensive. Measures of social and economic well-being would include job search activity, number of hours worked, job retention, trip purpose, engagement with DHS, and fare compliance.

Benefits to the District: At scale, the subsidy would represent a multimillion dollar annual investment from the District. While the number of trips taken will be an important outcome captured in administrative data, the additional data collection will capture a full picture of how lives change (or do not) when barriers to transit are lessened. The accuracy and completeness of the data collected will be vital to determining if a free or subsidized fare is worthwhile for the District. Measuring a wider scope outcomes during a pilot will also allow us to respond to inquiries from Council and the community at large about the potential benefits of improved transit equity.

TIME/COST ESTIMATE
Timeline: 18 months
The research team has already completed several milestones preparing for this pilot, so the timeline is already in motion:

June 2019	Joint proposal submitted to the City Administrator and approved
September 2019	Surveys to collect user feedback on fare product design completed
October 2019	Joint proposal submitted to the WMATA Board
November-December 2019	WMATA develops and user-tests the subsidized products; The Lab, DDOT, and DHS develop a detailed enrollment and data collection plan

January-November 2020   SNAP and TANF participants are enrolled and data is collected
December 2020-March 2021   The Lab and World Bank conduct data analysis
April 2020   Final report submitted to DDOT

Costs: The total cost of this project is expected to be $1,168,933. This proposal seeks $327,679 for SmarTrip data quality assurance and for non-administrative data collection costs.

Item	Amount budgeted	Covered by local funds	Covered by J-PAL	Requested from DDOT
1. Project Personnel	$81,121	$0	$81,121	$0
2. Fringe	$15,089	$0	$15,089	$0
3. Baseline Survey	$18,169	$0	$1,453	$16,716
4. Mobile Surveys	$223,032	$0	$0	$223,032
5. Supplies	$2,337	$0	$2,337	$0
6. Intervention Costs	$741,254	$741,254	$0	$0
7. Data Quality	$87,930	$0	$0	$87,930
Total	**$1,168,933**	**$741,254**	**$100,000**	**$327,679**