UTC-Semi-Annual Progress Report

Portland State University

Submitted to:	U.S. Department of Transportation Office of the Secretary-Research
Grant Number:	69A3551747112
Project Title:	National University Transportation Center National Institute for Transportation and Communities (NITC) *Consortium members: Portland State University (PSU), Oregon Institute of Technology (OR Tech), University of Arizona (UA), University of Oregon (UO), University of Texas at Arlington (UTA), University of Utah (UU)*
Center Director:	Jennifer Dill, Ph.D. Professor, Portland State University Director, National Institute for Transportation and Communities (NITC) jdill@pdx.edu 503-725-2855
Submitting Official:	same as above
Submission Date:	April 30, 2023
DUNS:	05-222-6800
Recipient Organization:	Portland State University PO Box 751, Portland, OR 97207-0751
Grant Period:	November 30, 2016 – September 30, 2023
Reporting Period End Date:	March 31, 2023
Report Term:	Semi-annual
Signature:	

Table of Contents

1 ACCOMPLISHMENTS: What was done? What was learned? 4
1.1 What are the major goals of the program? 4
Research 4
Leadership 4
Education and Workforce Development 5
Technology Transfer 5
Collaboration 5
Diversity 6
1.2 What was accomplished under these goals? 6
1.2.1 Research 6
Transportation for Livable Communities Pooled Fund Research 6
1.2.2 Leadership 7
High Standing within National and International Arenas of Transportation 7
Solving Regional and National Transportation Problems 7
Future Leaders 8
Development and Delivery of Programs 8
1.2.3 Education and Workforce Development 9
Offer Degrees and Courses in Multiple Disciplines 9
Provide Experiential Learning. 9
Develop Innovative New Curriculum and Learning Opportunities. 9
Educate Professionals 9
Attract and Support Undergraduate Students. 10
Attract and Support Graduate Students. 10
1.2.4 Technology Transfer 11
Move Research into Practice. 11
Use Innovative Approaches to Communicate Research Results. 11
1.2.5 Collaboration 12
Collaborating within our consortium. 12
1.2.6 Diversity 12
Attract underrepresented students to transportation careers 12
1.3 How have the results been disseminated? 13
1.4 What do you plan to do during the next reporting period to accomplish the goals? 13
2 PARTICIPANTS & COLLABORATING ORGANIZATIONS: Who has been involved? 13
2.1 What organizations have been involved as partners? 13
2.2 Have other collaborators or contacts been involved? 13
3 OUTPUTS: What new research, technology or process has the program produced? 14
3.1 Publications, conference papers, presentations, and events 14

3.2 Websites or other Internet sites 14
3.3 Events to support technology transfer 15
3.4 Technologies or techniques 15
3.5 Inventions, patent applications, and/or licenses 15
3.6 Other products 15
4 OUTCOMES: What outcomes has the program produced? 15
5 IMPACTS: What is the impact of the program? How has it contributed to improve the transportation system: safety, reliability, durability, etc.; transportation education; and the workforce? 15
5.1 What is the impact on the effectiveness of the transportation system? 16
5.2 What is the impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company? 16
5.3 What is the impact on the body of scientific knowledge? 17
5.4 What is the impact on transportation workforce development? 17
6 CHANGES/PROBLEMS 17
6.1 Changes in approach and reasons for change 17
6.2 Changes that have a significant impact on expenditures 17
6.3 Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards 17
6.4 Change of primary performance site location from that originally proposed 17
7 SPECIAL REPORTING REQUIREMENTS 18
4 APPENDIX 19
Table 1: Initial Research Projects 19
Table 2: Round 1 Research Projects 19
Table 3: Round 2 Research Projects 20
Table 4: Round 3 Research Projects funded by NITC in 2019 22
Table 5: Round 4 Research Projects funded by NITC in 2020 23
Table 6: Round 5 Research Projects 24
Table 7: Translate Research to Practice Projects 25
Table 8. Student group activities during this reporting period 26
Table 9. List of publications resulting from work funded by NITC. 29
Table 10: Organizations partnering with NITC projects. 34
Table 11. Technology Transfer Performance Metrics 37

1 ACCOMPLISHMENTS: What was done? What was learned?

1.1 What are the major goals of the program?

The major goals for NITC as described in our application fall into six categories:

Research

- **Build and extend existing research through Year 1 projects**. The first year of funding will support projects that extend some of our existing work, supplemented by a competitive peer-review process to select additional projects proposed by researchers of our consortium.
- **Competitive, peer-review project selection process in Years 2 through 5.** Our projects in Years 2 through 5 will be selected through a competitive request for proposal (RFP) process. These funds will be available for projects consistent with our theme.
- **Pooled Fund Research.** We will continue the Pooled Fund Research program which offers a process by which cities, counties, MPOs and other regional or local agencies can pool relatively small pots of research dollars to then leverage NITC matched funds for a single, collaborative project.

Leadership

- **High Standing within National and International Arenas of Transportation.** NITC faculty will continue to demonstrate leadership by disseminating their research within and outside of academia. NITC faculty help address national transportation problems through volunteer leadership on TRB committees and in other positions. By serving on these committees, faculty help set national research agendas and connect with agency leaders and practitioners on pressing research issues. To continue and reinforce this practice, NITC will mentor our new, tenure-track faculty to apply for committee and panel membership and recognize the activities of all faculty members.
- **Solving Regional and National Transportation Problems.** NITC's director and staff will serve as points of contact for agency leaders and policymakers regionally, statewide and nationally. When we identify needs that match the expertise of our researchers, we will make a connection. We will work with key staff at the DOT modal administrations, both in Washington, D.C. and within our regions, to determine the most effective way for our researchers to learn from and inform agency activities.
- **Future Leaders**. We recognize the investment we must make in our young faculty and students by prioritizing research projects that include them. We will also support students traveling to conferences to present their work, a key activity in developing the next generation of leaders.
- **Development and Delivery of Programs.** We demonstrate our leadership in innovating transportation education, workforce development, deployment of research results and conducting research.

Education and Workforce Development

- **Offer Degrees and Courses in Multiple Disciplines.** NITC university partners will continue to offer a rich array of degrees that serve the transportation profession.
- **Provide Experiential Learning.** Our campuses will continue to provide experiential learning opportunities, and NITC will seek ways to expand them.
- **Develop Innovative New Curriculum and Learning Opportunities.** We will develop a new, innovative curriculum that can be tested and shared among NITC and other universities.
- **Educate Professionals.** NITC will maintain a vibrant program of seminars, workshops, professional courses and other training opportunities that provide practitioners with the latest tools and techniques.
- **Attract and Support Undergraduate Students.** NITC will support projects and initiatives that expose middle and high school students to transportation concepts and careers. The efforts aim to attract and retain new undergraduate students to our degree programs, involve undergraduates in our research, increase the number of women and students of color in these programs, and expand the diversity and capacity of the transportation workforce.
- **Attract and Support Graduate Students.** NITC will support graduate students directly through research assistantships working on projects. We will provide dissertation fellowships for students to research surface transportation topics that fit under the NITC theme. This will be a competitive process open to Ph.D. students at NITC universities multiple times throughout the year.

Technology Transfer

- **Move Research into Practice.** We aim to bridge research and practice by interpreting results, and identifying how and by whom they can be best applied in practice. Our Technology Transfer Plan systemizes the integration of research into practice. As part of this plan, projects are given a ranking based on their technology readiness level and an implementation plan is developed for all projects showing implementation potential based on this ranking. This process will ensure research results have a greater chance of being used in practice.
- **Use Innovative Approaches to Communicate Research Results**. NITC will embark on an ambitious program of sharing information through traditional and new media.

Collaboration

- **Collaborate within our consortium.** Our governance structure is cooperative and leadership is distributed. The Executive Committee includes one faculty member from each campus, and it provides overall direction for the Center, makes project funding decisions, and selects NITC award recipients, including student of the year. They will meet in person at least once a year, rotating the location between campuses, and hold regular conference calls. Each Executive Committee member will be responsible for representing and supporting their respective campus.

- **Collaborate externally.** In addition to the partnerships that occur through individual projects and the pooled-fund program, NITC will foster collaboration with a range of "end-users" of our work through an External Advisory Board. As the national UTC for improving the mobility of people and goods, NITC will work with OST-R staff to foster collaboration between all the UTCs focusing on this DOT priority. Primary aims will be to avoid duplication of efforts and identify opportunities for collaboration.

Diversity

- **Attract underrepresented students to transportation careers**. We aim to attract underrepresented students to transportation through programs that target middle, high school, or elementary school students. We do this by providing funds to researchers who engage underrepresented students in their projects, collaborating with WTS, STEM and education experts, and expanding our National Summer Transportation Institute (NSTI) Program to partner campuses.
- **Priority funding to research with an equity focus.** We give priority to funding research projects that have an equity focus by awarding them additional points in the RFP process.

1.2 What was accomplished under these goals?

1.2.1 Research

NITC has funded research through various grant competitions. The General Research grant program supported larger-scale projects. The Small Starts grant program funded researchers who had not yet had the opportunity to undertake significant transportation research. All projects were consistent with NITC's theme, externally peer-reviewed, and selected by the NITC Executive Committee via consensus. We selected projects through five competitive grants cycles. Of the 79 research projects funded, 62 are complete with final reports posted online, 17 are active (research being completed) and/or in various stages of finalizing the projects including report submission, final report peer-review and editing. The projects and status can be found in the Appendix, Tables 1-6.

Transportation for Livable Communities Pooled Fund Research

NITC's Pooled Fund program offered a process by which cities, counties, MPOs and other regional or local agencies can pool relatively small pots of research dollars to then leverage NITC matched funds for a single, collaborative project. Two Pooled Fund Projects were funded by NITC and partners. Both projects, Applying an Equity Lens to Automated Payment Solutions for Public Transportation and Exploring Data Fusion Techniques to Derive Bicycle Volumes on a Network, are complete and the final reports are available online.

Research Roadmaps

Six multidisciplinary, multicampus teams (at least one researcher from each university for a total of 35 researchers) worked together on developing these Research Roadmaps: transportation, land use and housing (including economic impacts); supporting underserved communities in advancing equitable mobility; bicycle transportation; technology and new mobility; resiliency; and multimodal data and modeling.

The Research Roadmaps aim to assess the cumulative body of UTC-funded research and help define what future research and workforce development efforts UTCs can embark on to meet the most important challenges facing transportation agencies and policymakers. Each Research Roadmap included the following: overview, current knowledge, research gaps, and workforce needs. During the process of developing the Roadmap, each team held at least one virtual workshop with practitioners to help assess key gaps and workforce needs. These are complete and available on-line.

1.2.2 Leadership

High Standing within National and International Arenas of Transportation

- NITC researchers and students gave a total of 81 presentations, as well as presiding over more than ten sessions, panel discussions and committee meetings, at the 102nd annual meeting of the Transportation Research Board (TRB) in January 2023.

- Researchers Sarah Canham, Jeff Rose, Shannon Jones, Alannah Clay and Ivis Garcia of the University of Utah (UU) published an article in *Health & Social Care in the Community.* The article, "Community perspectives on how decentralizing an emergency shelter influences transportation needs and use for persons experiencing homelessness," offers evidence to support the need for no-cost transportation options for persons experiencing homelessness. The paper also provides information about transportation barriers to health and social care for persons experiencing homelessness.

- Researchers Ivis Garcia, Sadika Maheruma Khan, and Kevin Fagundo-Ojeda of the University of Utah with Miriam Abelson and Nicholas Puczkowskyj of Portland State University published a new article in the November 2022 issue of *Transportation Research Part D: Transport and Environment*. Scholarship on gendered mobilities has shown that women experience transit differently than men do, particularly regarding personal safety. The article, "Harassment of low-income women on transit: A photovoice project in Oregon and Utah," makes a unique contribution to this body of literature because it shows that women feel targeted also based on their racial or ethnic identity and not only their gender. The article discusses women's actions every day to increase their sense of safety.

- Researchers Jennifer Dill and Nathan McNeil are partnering with Shiga University in Japan to assist in conducting research on neighborhood greenways. Katsuya Tanaka of Shiga University was a visiting scholar at PSU and has an interest in green infrastructure including neighborhood greenways. Dill and McNeil are working with Dr. Tanaka to conduct a survey of neighborhood greenways in Portland and combine elements of views on green infrastructure with active transportation and other elements. The survey methodology includes sampling many of the same neighborhood greenway areas / corridors in a previous study between 2010 and 2012, giving them the opportunity to compare results over time.

Solving Regional and National Transportation Problems

During this reporting period, activities and progress in this goal area include:

- John MacArthur provided public testimony on Oregon HB2571on February 8th. He presented his e-Bike research to help inform and shape the program. Oregon HB2571 directs the Department of Environmental Quality to establish a program for providing rebates to qualifying individuals who purchase electric assisted bicycles or cargo electric bicycles and qualifying equipment.

- Survivors of intimate partner violence (IPV) experience transportation disadvantages, sometimes due to financial constraints caused by their abusive partners, which can keep them from accessing

essential resources. Sarah Leat of the University of Memphis School of Social Work published an article in the December 2022 *Journal of Transport & Health* examining how shared mobility services could help fill this transportation gap. Leat, who earned her PhD from the University of Texas at Arlington (UTA), began researching transportation challenges among IPV survivors when she was a NITC Dissertation Fellow at UTA.

- Martin Swobodzinski and Amy Parker of Portland State University worked with graduate students in PSU's departments of Geography and Special Education, as well as Elizabeth Schaller and Denise Snow of the American Printing House for the Blind, to explore low-cost methods to enable people with visual impairments to more easily move through public, urban indoor and outdoor spaces. Navigating an unfamiliar place is uniquely challenging for people with disabilities. People with blindness, deafblindness, visual impairment or low vision, as well as those who use wheelchairs, can travel more independently in urban areas with the aid of effective wayfinding technology.
- BikePed Portal, over the decade since being initially launched by NITC seed funding, has grown into a centralized repository that contains biking and walking data from places all over the United States. This year a data dashboard for the greater Washington, D.C. metro area was added to BikePed Portal, allowing users to see D.C. bike data from several jurisdictions all together in one place.
- Jennifer Dill attended the Tribal College/University – UTC Summit to help facilitate transportation research and education opportunities and to cultivate relationships with tribal colleges.
- John MacArthur was appointed to the TriMet Transit Equity Advisory Committee (TEAC). Members of TEAC help reduce inequities across TriMet's transportation systems and the communities they affect.

Future Leaders

NITC support plays a critical role in developing students and faculty as leaders in their discipline through supporting research projects that include them.

Anne Brown's NITC funded research was featured in an article in Next City "How Cities Can Make Micromobility Accessible to Underserved Communities." This adds to her growing portfolio of media coverage of her research.

Development and Delivery of Programs

Our communications team leads the way in promoting NITC, UTC, and other transportation agencies' research outcomes and transportation events to the public via newsletters and social media. Our projects' final reports and other products are published and freely available for download from NITC's project websites. They are also available from PSU's institutional repository, PDXScholar. For this report, we have included download data from both sources.

Downloads of NITC Outputs	**10/1/2022 – 3/31/2023**
Final reports	3,903
Project briefs	4,899
Datasets	101

Downloads of final reports from project websites require downloaders to provide their email address,

which NITC uses to request feedback. During this period, 96 people completed surveys on NITC reports: 44 practitioners, 17 faculty/researchers, 9 students, and 26 other stakeholders. Thirty-three of the respondents indicated that they downloaded the report to help make decisions about practice. Ninety percent of them rated the reports as very or somewhat useful, with 61% saying the reports met their needs, and 93% rated the clarity of reports as excellent or good.

1.2.3 Education and Workforce Development

Offer Degrees and Courses in Multiple Disciplines

The six-university consortium offers a total of 2 certificates, 17 bachelor, 23 master's and 10 PhD programs in transportation and closely related fields, including several dual degree options.

Provide Experiential Learning.

Our campuses connect transportation-focused students to community partners and employment opportunities by engaging them in activities and research that build on their course learning.

Alonso Carrillo, a dual masters student studying urban planning and real estate development at the University of Arizona (UA), worked with UA faculty on a NITC project documenting strategies to create affordable housing units in TODs or TOD-like areas. Carrillo is the recipient of a 2022 fellowship from the UA Center for Applied Transportation Sciences and a 2023 Transportation Research Board (TRB) Minority Student Fellow. "Post-graduation, I plan on seeking employment with a firm that specializes in the development of mixed-income TODs," Carrillo said.

NITC supports student groups on each of our partner campuses. The student groups have been active this past academic year. During this reporting period, a total of 35 meetings/events were attended by 875 participants (Appendix, Table 8).

Peirong (Slade) Wang, PhD student in transportation engineering at the University of Texas at Arlington (UTA), worked with Dr. Taylor Li, UTA, on the NITC Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors. "Working on this project taught me a lot and inspired me to reflect on how, for decades, we have primarily focused on mobility for drivers while overlooking the safety of other road users at intersections. With new sensing technologies like LIDAR, I am excited to see future traffic designs that prioritize safety for all road users," Wang said.

UO is partnering with the city of Sisters, Oregon for the Sustainable City Year Program. In the fall, students worked on a new future for the Sisters Elementary School site and affordable housing funding options.

PSU students in the Active Transportation Planning Studio worked with community partners on two significant projects. One student team of students developed a new "living streets" concept for Portland's city center. Another team worked on planning and redesigning an intersection in a northeast Portland neighborhood from a dangerous corner into a welcoming neighborhood space, in a community which is 47 percent Black, Indigenous and people of color.

Develop Innovative New Curriculum and Learning Opportunities.

Educate Professionals

During the reporting period, NITC supported 15 events that were attended by 1169 people: 4 NITC webinars with a total of 274 attendees, 8 transportation Seminars with 690 attendees and 3 other events with 205 attendees. The webinars and seminars are open to the public, webcasted to enable professionals and individuals across the country to participate, and recordings are posted on

NITC/TREC websites. Each of these events offered one AICP professional development credit. During this period, APA awarded practitioners 901 AICP credits, and the practitioners rated TREC's events 4.01 out of 5 stars. Since 2000, the events have a 4.0 out of 5 rating from 14,719 reviews.

Two engineers from the City of Cincinnati's Department of Transportation & Engineering—Joe Conway and Brian Goubeaux—attended IBPI Comprehensive Bikeway Design in the summer of 2022 and brought some inspiration home. The City of Cincinnati is in the process of updating its Bicycle Transportation Plan, adopted in 2010 and due for a refresh. Goubeaux, a senior engineer for the City, said that design strategies and practices he learned during the summer workshop will likely find their way into the plan. Other attendees from the same workshop, at City of Vancouver, WSDOT and Delaware Valley Regional Planning Commission, had similar stories to share.

Attract and Support Undergraduate Students.

NITC recognizes that transportation workforce development does not always take place at the university level. Students' interest in transportation can start much earlier, which is why NITC aims to attract and retain new undergraduate students to transportation-related degree programs and increase the number of underrepresented students in these programs.

NITC funding supports student group activities. Oregon Tech's ITE student chapter won two Oregon ITE Traffic Bowl championships. We interviewed student chapter president and civil engineering bachelors student Leif Tuel, who said "In the post pandemic world, many ITE chapters were left picking up the pieces of their clubs. Oregon Tech is a much smaller and close-knit school, which allowed us to keep our civil engineering clubs together and active. As the current Oregon Tech ITE Chapter President and a member of four years, I am trying to expand our reach as a club and create new events to deepen our membership and civil engineering department. One such event is to hold our own inter-university quiz style game, to encourage interest in Traffic Bowl while also providing a venue for some fun friendly competition. As a member of our ITE chapter we won two years in a row at the Bill Kloos Annual Traffic Bowl, held for the Oregon ITE sections. I also had the pleasure of competing at the 2022 ITE Western District Student Traffic Bowl, where we placed third overall."

LiveMove, the University of Oregon's transportation student group, is working on a "Eugene Sidewalk Inventory," a club effort to document sidewalk conditions and crossing treatments in the City of Eugene. Currently, the City of Eugene has geographic data on where there are sidewalk facilities but is unsure what state they are in. With guidance from Professor Anne Brown, students including undergrad Matt McCreary researched ADA sidewalk requirements, sidewalk inventory work from other cities, and types of crossing treatments. Following their research, an ArcGIS Survey123 survey tool was created to collect sidewalk condition data, and currently members of LiveMove are working on data collection for the next few months. When the project is finished, LiveMove will have created a comprehensive database of all sidewalk conditions in Eugene, allowing for the city to fix areas of concern.

Attract and Support Graduate Students.

Twelve students attending NITC partner universities received Eisenhower Fellowships presented by the U.S. Department of Transportation at this year's annual meeting of the Transportation Research Board (TRB).

PhD candidate Nicholas Puczkowskyj of Portland State University, a graduate research and teaching assistant at PSU's College of Urban and Public Affairs, was awarded a NITC dissertation fellowship to support his doctoral research project "Expanding Transmobilities: An Art-Informed Methodology For Genderdiverse Travel Behavior." There is a significant gendered travel behavior research gap in the

transportation literature. The burgeoning field of transmobilities investigates transgender mobility and evolved from the nexus of mobility justice and gender studies by studying transgender experiences on public transit.

Farzin Maniei of the University of Texas at Arlington was awarded a NITC dissertation fellowship to support his doctoral research project: Unsupervised Approach to Investigate Urban Traffic Crashes Based on Crash Unit, Crash Severity, and Manner of Collision. ""Knowing that there has not been a day without a fatality on Texas roadway since November 7th, 2000, I have been encouraged to focus my dissertation on traffic safety analysis and traffic crash prediction models to mitigate the socioeconomic burden of traffic crashes," Maniei said.

Adrian Cottam of the University of Arizona was awarded a NITC dissertation fellowship to support his doctoral research project, "Machine Learning and Big Data-Based Approaches for Quality Freeway Volumes," which will focus on improving the quality of freeway volumes and expanding their spatial availability. "I am a firm believer in applied research, and hope to better my community through my research efforts. As such, I seek to develop methods that can be applied in a practical way, so that local transportation engineers can have better data to make more informed decisions for Arizona roadways," Cottam said.

1.2.4 Technology Transfer

Move Research into Practice.

NITC's Translate Research to Practice initiative allows researchers to build on previous NITC projects' accomplishments, strengthen partnerships with transportation agencies and community organizations, and produce outputs for practitioners. NITC awarded seven projects (Appendix, Table 7). Five of the projects are complete and actively implemented across the country.

Nathan McNeil presented the Transportation Academy project to the NHTSA Region 3 Leadership Meeting on Communications, Outreach and Engagement on Nov 30, 2022. The audience was primarily Region 3 state DOTs reps working on outreach and engagement, along with some NHTSA and FHWA staff. NHTSA Region 3 administrator, Stephanie Hancock, said, "Thank you so much for presenting at our Region 3 Highway Safety Leadership meeting yesterday. Your presentation was so very timely as the Bipartisan Infrastructure Law calls for more meaningful public engagement. I believe transportation academies are a great tool to help us achieve that goal. It is my hope that your presentation will lead to the development of more transportation academy-like programs in Region 3 as well as motivate state highway safety offices to do the research in identifying already existing ones that they could support. Again, thank you for delivering a fantastic, informative and resourceful presentation."

With funding from a NITC "Translate Research to Practice" grant, a team of University of Utah (UU) researchers led by Xiaoyue Cathy Liu and Jianli Chen created a bi-objective optimization framework which takes both cost and environmental equity into consideration, helping transit agencies achieve their desired environmental and public health-related outcomes in the most cost-effective way. Developed to help agencies transition their fleets to battery electric buses, the flexible framework is also a helpful tool for doing cost-benefit analysis on a range of other transit-related objectives.

Use Innovative Approaches to Communicate Research Results.

Visitors and engagement has grown across all social media platforms, the NITC website, and our newsletters. Updated daily, the NITC website saw 29,501 site visitors during this reporting period. Our highest engagement with U.S. web visitors by state is as follows: Oregon ,California, Texas, Virginia, and Utah.

We published twenty-one NITC stories on research results, newly funded projects, the impact of events, and monthly NITC Student Spotlight interviews. The Spotlights showcase the outstanding students supported by NITC funding, including student group leaders, NITC Dissertation Fellows, and research assistants on NITC-funded projects. All of these stories are shared in our monthly NITC newsletter with 5,839 subscribers (20% open rate; 19.9% click-through rate) dedicated to communicating NITC research and events.

Kelly Clifton, Portland State University, and Kristina Currans, University of Arizona, collaborated with PSU's Comics Studies program to create "Moving From Cars To People," a comic about transportation and land use. The comic offers a succinct and fun introduction to a complicated topic: namely, how the built environment in the United States came to be designed for cars and what we can do about it. Both physical and digital copies were made available. It's in everyone's interest for people who are not transportation professionals to have a working knowledge of the conversation around sustainable transportation options. When important policy questions show up on a ballot – for example, whether businesses should be required to provide a certain amount of parking spaces, or whether the state should subsidize public transit – people who aren't in the transportation industry might not be fully aware of the tradeoffs involved in these questions. This short graphic synopsis is an engaging, approachable way for anyone – no matter their level of expertise – to learn about the data, methods, and processes used to plan for multimodal transportation impacts of new development.

1.2.5 Collaboration

Collaborating within our consortium.

NITC's governance structure is collaborative and encourages multiple perspectives on decision-making. During this reporting period, the Executive Committee supported the multicampus research effort that involved each of the campuses to develop Research Roadmaps.

NITC also encourages our consortium faculty to collaborate on research projects. Almost half of the projects (43%) involve more than one consortium partner, and over half (57%) of the research projects included investigators from more than one discipline.

The 2022 NITC Students of the Year were Sadie Mae Palmatier, University Oregon, She was honored at the Council of University Transportation Centers (CUTC) banquet as NITC's Outstanding Student of the Year. Melrose Pan, University of Arizona; and Cameron Bennett, Portland State University were also recognized for their achievements by NITC.

External collaboration

External collaboration is a significant part of NITC's applied research and technology transfer projects in addition to course delivery.

UO's is partnering with the city of Sisters, Oregon for the Sustainable City Year Program. The partnership includes the City, School District, and Parks and Recreation District.

1.2.6 Diversity

Attract underrepresented students to transportation careers

NITC uses several approaches aimed at attracting women and people of color into the transportation field. This includes offering programs and fostering partnerships that achieve this goal. For example, grants to include underrepresented students in research have significant impact on positionality, how

differences in social position and power shape identities and access in society. Over half of our research projects have a significant focus on equity. In the Appendix, Tables 1-6, these 39 projects are indicated by asterisks after their titles. Programs such as the summer transportation institute and the transportation undergraduate research fellowship mentioned above prioritize and attract students from underrepresented groups.

Hau Hagedorn was a part of a transportation career panel facilitated by the Washington State Department of Services for the Blind. She talked about transportation careers and pathways alongside Martin Kareithi (Director of Systemwide Accessibility for CapMetro) and Ron Brooks (CEO of Accessible Avenue) to blind and visually impaired students.

With support from a NITC diversity grant, University of Arizona (UA) student Ash Avila has spent two years researching extreme heat in urban environments. An undergraduate in the Sustainable Built Environment program, Avila supported UA researchers Ladd Keith, Nicole Iroz-Elardo and Kristina Currans on their NITC project, Assessing Cool Corridor Heat Resilience Strategies for Human-Scale Transportation. "As a first-generation college student, I was not aware of academia as a field or what it was like to be involved in academic research," Avila said in a reflection paper about the diversity grant and her role on the project. This year she presented her work at TRB for the second time.

1.3 How have the results been disseminated?

Research results are disseminated through various venues that include presentations at conferences, monthly webinars and through papers and reports. The NITC communication team delivers a monthly newsletter on NITC research, tech transfer opportunities, and researcher accomplishments to 5,839 subscribers, as well as social media channels on Twitter, Facebook, YouTube, and LinkedIn. These efforts are described in more detail in sections 1.2.4, 3.1 and 3.2.

1.4 What do you plan to do during the next reporting period to accomplish the goals?

We currently are working to close out the grant and projects. We expect to continue reporting on research projects, technology transfer activities, and student updates.

2 *PARTICIPANTS & COLLABORATING ORGANIZATIONS: Who has been involved?*

2.1 What organizations have been involved as partners?

Each NITC research project must be supported by matching funds. Overall, NITC projects have 89 non-university partners providing matching funds, or contributions in other ways (Appendix, Table 10). This includes partners from local governments, non-profits, regional government agencies, state DOTs, transit agencies, and industry partners.

2.2 Have other collaborators or contacts been involved?

Cathy Liu, UU, and her research team presented their work on a Battery Electric Bus visualization tool to Sun Tran (Arizona) as an additional transit agency to demonstrate tech transfer. Sun Tran is in the process of retrieving needed data and the research team will implement their network using our

optimization pipeline to demonstrate the BEB deployment effectiveness. Salt Lake County is also interested in their modeling result and to further guide the BEB investment.

We work closely with external partners to transfer knowledge and to connect practice with academia through our transportation seminars, webinars and workshops. During this reporting period, we have worked with the following partner organizations: Portland Bureau of Transportation, Washington Department of Transportation, Oregon Department of Transportation, Thuy Tu Consulting, TriMet, Sightline Institute, and EcoCounter.

3 *OUTPUTS: What new research, technology or process has the program produced?*

Technology transfer performance measures are summarized in Table 11.

3.1 Publications, conference papers, presentations, and events

Fifty-eight papers based on research from this FAST Act grant have been published in peer-reviewed journals, including seven during this reporting period. They have been cited 615 times, up from 391 on September 30, 2022. (Appendix, Table 9).

3.2 Websites or other Internet sites

We leverage our strong online and social media presence to promote our research findings, expand the reach of our education, and elevate our faculty and student researchers. We also raise awareness of important transportation issues nationwide and findings that advance our center's theme.

- NITC website: Updated daily, the website provides comprehensive information about our center and complete research portfolio. This includes stories about our research, press coverage, tech transfer resources, professional development events, and opportunities for students.
- Twitter (TREC: 4,018): We promote NITC-sponsored research, publications, and events while also uplifting the activities of fellow UTCs. We share news and achievements from NITC-funded students, faculty, and ongoing projects.
- NITC_UTC twitter 749 followers, +86) offers more effective framing of the consortium partnership.
- Facebook (1,104, +14): In addition to sharing research, this platform shares photos of our events and offers connections with other organizations, researchers, and practitioners.
- YouTube (1,321 subscribers, +141): Where we publish freely accessible video recordings of weekly seminars at PSU, monthly NITC webinars, special lectures, student spotlights and more.
- LinkedIn (1450 followers, +383): We target transportation professionals to share tools, practical information, and our latest studies.
- Flickr: An archive of photo collections from events we hosted or attended, most notably used to showcase the presence of NITC researchers and students at the annual meeting of TRB.

- Instagram (808 followers, +74): This platform introduces the people behind the research and puts a face to the center. Instagram has provided a high level of engagement, which we expect to help both our technology transfer and student recruitment efforts.

3.3 Events to support technology transfer

As described under Educating Professionals, NITC supported webinars (4) and Friday Transportation Seminars (8) that were attended by 960 people. These events are eligible for AICP professional development credit.

3.4 Technologies or techniques

Nothing new to report.

3.5 Inventions, patent applications, and/or licenses

We have worked with PSU's Innovation & Intellectual Property to license BikePed Portal, a non-motorized count database and management system. It is being enhanced through a project to add trail counts in the National Capital Region and funded by the National Park Service. We are also working to update and license NITC's Project and Proposal Management System that is used to manage requests for proposals, peer-reviews, and manage UTC projects.

3.6 Other products

N/A

4 OUTCOMES: What outcomes has the program produced?

Research Outcomes

NITC uses two measures to track research outcomes:

1. Number of stakeholders who collaborated on implementing research outcomes: 5
   They included: Utah Transit Authority, Wasatch Front Regional Council, Utah Department of Transportation, Salt Lake County, Salt Lake City Transportation Division

2. Number of projects that reach deployment and adoption (measured by the number of projects that reach TRL scale 4 or 5): 20 total

5 IMPACTS: What is the impact of the program? How has it contributed to improve the transportation system: safety, reliability, durability, etc.; transportation education; and the workforce?

The impacts of the NITC program are achieved through interdisciplinary collaboration, our strong and intentional partner relationships, and the active participation of professionals that informs our educational offerings. Technology transfer performance measures are summarized in Table 11. Sixty-two research projects have been completed to date and we are working with stakeholders to assess the

impact of the work. This section provides some of the recent impacts from projects funded through the current FAST Act grant and previous UTC grants (MAP-21, SAFETEA-LU).

5.1 What is the impact on the effectiveness of the transportation system?

NITC's e-bike studies continue to have an impact on practices and policies across the country. The e-bike user surveys (led by John MacArthur and Chris Cherry) are referenced in detail in Cycling Utah Magazine: "Lets face it: electric bicycles have become a significant part of the cycling community, both for transportation and recreation. But research into who rides them and their effect on the bicycle business is lacking. In an attempt to partially fix this lack of knowledge, researchers at the National Institute for Transportation & Communities at Portland State University in Oregon surveyed owners in 2013. To see what has changed since then, they released a follow-up in March 2018." Practitioners from New Mexico, Ohio, and Colorado are looking at the research to inform state level e-bike rebate policies. The city's of San Jose, CA and Bloomington, IN are also referring to the research to inform their local policies.

There is renewed interest in national legislation to offer $1,500 refund on e-bikes through the E-BIKE Act. Informed by NITC research, "if just 15% of all urban trips were made by e-bike, it would result in a reduction of 12 million metric tons of carbon dioxide emissions per year. This would be equivalent to taking 2.5 million cars off the road." as reported in Magicycle Magazine. Since the last reporting period, there have been nine media coverage stories that include NITC-funded e-bike research.

Taylor Li, University of Texas Arlington; Sirisha Kothuri, Portland State University; and Xianfeng (Terry) Yang, University of Utah, developed a system for collecting pedestrian behavior data using LiDAR sensors. Tested at two intersections in Texas and soon to be tested at another in Salt Lake City, Utah, the new software created by a multi-university research team is able to reliably observe pedestrian behavior and can help reduce conflicts between pedestrians and vehicles at signalized intersections. The Utah Department of Transportation (UDOT) is already working on implementing this new system to improve data collection at intersections. Mark Taylor, a traffic signal operations engineer for the Utah Department of Transportation (UDOT), is optimistic that the new sensor system can offer important functionality based on its improved bicycle and pedestrian detection. "We have these goals and objectives to make our intersections and our roadways safe, and safer for all modes of travel. Not just vehicles, and not just buses and trucks, but the vulnerable road users as well; bikes as well as pedestrians, and with zero fatalities. The big thing about LiDAR is you're able to get a 3D image of everything around you and what is happening in real time. With this system, you're able to look at things like red light running and near misses for pedestrians and vehicles, and you're able to see a lot more information that the traditional detector is not able to provide you with," Taylor said.

Researchers Charles (C.J.) Riley and Ashton Greer, Oregon Institute of Technology, have improved ADA accessibility on a pilot section of trail using a NITC-developed sustainable paving method. A quarter-mile section of the Klamath Geo Trail, just east and up the hill from the Oregon Tech Klamath Falls campus, has been successfully resurfaced using volcanic ash from Mount Mazama. The trail treatment was successful, resulting in a firmer surface that wheels wouldn't sink into.

5.2 What is the impact on the adoption of new practices, or instances where research outcomes have led to the initiation of a start-up company?

Nothing new to report.

5.3 What is the impact on the body of scientific knowledge?

We measure the impact on scientific knowledge from surveys of faculty, researchers and students that downloaded NITC final reports, and indicate their purpose was for a research, thesis, dissertation proposal or project. During this period, these stakeholders cited NITC reports in their work and used them to inform their scientific knowledge.

For example, an employee of Daimler Trucks read the final report for the research project "Statistical Inference for Multimodal Travel Time Reliability" for general knowledge on methods of processing transportation data. A professor from the University of Tsukuba noted that they'll use a NITC report in their class noting that, "The material is beneficial, especially for Japanese students who are literate in comics."

UA's NITC-funded research on cool pavement was instrumental in helping win $3.5 million from the U.S. Department of Energy to study the challenges of increasingly extreme weather.

5.4 What is the impact on transportation workforce development?

The skills and knowledge of the current transportation workforce needs to keep pace with the changing technology, policy, and best practices. NITC has made significant impacts training the current transportation workforce in several areas. Webinars and seminars are important to building the skills and knowledge for the current workforce. Since the last reporting period, we received feedback from 350 webinar / seminar participants where 96% noted that the purpose for attending was professional development; with 91% indicated that the training met their purposes. One of the respondents noted, "I love hearing from real field practitioners rather than just researchers. You could tell that the presenter really cares about what he does and does it daily." This reinforces our collaboration with agencies and practitioners in highlighting and sharing their work. NITC's research plays an important role in continuing to help educate the current transportation workforce.

6 CHANGES/PROBLEMS

6.1 Changes in approach and reasons for change

The focus of NITC moving forward will be on closing out the grant.

6.2 Changes that have a significant impact on expenditures

There are no significant impacts on expenditures.

6.3 Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards

No significant changes.

6.4 Change of primary performance site location from that originally proposed

No updates.

7 SPECIAL REPORTING REQUIREMENTS

No requirements.

4 APPENDIX

Table 1: Initial Research Projects

Grant	Project Title	Investigators	Univ.	Status
Initial Projects	Access to Opportunities: Redefining Planning Methods and Measures for Disadvantaged Populations*	Arlie Adkins Stephen Mattingly	UA, UTA	Active
	Bringing Bikes into the V2X Smart City Conversation	Stephen Fickas Marc Schlossberg	UO	Complete
	Economic and Business Impacts of Non-Motorized Bike/Pedestrian Infrastructure	Jenny Liu Jennifer Dill	PSU	Complete
	Evaluating Improved Transit Connections for Ladders of Opportunity *	Stephen Mattingly Yi-Chang Chiu	UTA UA	Active (final report pending)
	From Knowledge to Practice: Rethinking Streets for People on Bikes	Marc Schlossberg Roger Lindgren	UO OIT	Complete
	Improving Integration of Transit Operations and Bicycle Infrastructure at the Stop Level	Miguel Figliozzi Chris Monsere	PSU	Complete
	Key Enhancements to Four-Step Travel Demand Models	Reid Ewing	UU	Complete
	Network Effects of Disruptive Traffic Events	Juan Medina Cathy Liu	UU	Complete
	Social-Transportation Analytic Toolbox (STAT) for Transit Networks *	Cathy Liu Ran Wei Aaron Golub Liming Wang	UU PSU	Complete
	Foundational Smart Cities Platform for NITC	Kristin Tufte John MacArthur Larry Head	PSU PSU UA	Active (final report pending)

*Research projects that address equity related to mobility

Table 2: Round 1 Research Projects

Grant	Project Title	Investigators	Univ.	Status
General Research	Updating and Expanding LRT/BRT/SCT/CRT Data and Analysis	Arthur C. Nelson	UA	Complete
	Life-Space Mobility and Aging in Place*	Ivis Garcia Zambrana Keith Dias Moore Alan DeLaTorre	UU PSU	Complete

Grant	Project Title	Investigators	Univ.	Status
	Understanding Factors Affecting Arterial Reliability Performance Metrics	Avinash Unnikrishnan Sirisha Kothuri	PSU	Complete
	Planning in Gateway and Amenity Communities: Understanding Unique Challenges Associated with Transportation, Mobility, and Access to Opportunity*	Danya Rumore Philip Stoker	UU UA	Complete
	Developing Data, Models, and Tools to Enhance Transportation Equity*	Amy Lubitow Julius McGee Raoul Lievanos	PSU UO	Complete
	Universally Accessible Trail Improvement with Naturally Occurring, Sustainable Materials*	Matthew Sleep	OIT	Complete
Small Starts	A Decentralized Network Consensus Control Approach for Urban Traffic Signal Optimization	Gerardo Lafferriere	PSU	Complete
	Is There a "Buy Local" Case for Lower Travel Speeds? Testing Differences in Driver Recognition of Local versus National Retail at Different Travel Speeds	Jonathan Bean Arlie Adkins	UA	Active
	How Will Autonomous Vehicles Change Local Government Budgeting and Finance? A Case Study of Solid Waste, Drop-off/Pick-up Zones, and Parking.	Benjamin Clark	UO	Complete
	Vehicle Sensor Data (VSD) Based Traffic Control in Connected Automated Vehicle (CAV) Environment	Xianfeng Yang	UU	Complete
	How Can Interdisciplinary Teams Leverage Emerging Technologies to Respond to Transportation Infrastructure Needs? A Mixed-Methods Evaluation of Civil Engineers, Urban Planning, and Social Workers' Perspectives. *	Noelle Fields Courtney Cronley Kate Hyun Stephen Mattingly	UTA	Complete
	A Comprehensive Examination of Electronic Wayfinding Technology for Visually Impaired Travelers in an Urban Environment*	Martin Swobodzinski Amy Parker	PSU	Complete

*Research projects that address equity related to mobility

Table 3: Round 2 Research Projects

Grant	Project Title	Investigators	Univ.	Status
General Research	The Connection between Investments in Bus Stops, Ridership, and ADA Accessibility*	Keith Bartholomew Arlie Adkins	UU UA	Complete
	Investigating Effects of TNCs on Parking Demand and Revenues	Benjamin Clark Anne Brown	UO	Complete

Grant	Project Title	Investigators	Univ.	Status
	Matching the Speed of Technology with the Speed of Local Government: Developing Flexible Codes and Policies Related to the Possible Impacts of Autonomous Vehicles on Cities	Marc Schlossberg Heather Brinton	UO	Complete
	Reducing VMT, Encouraging Walk Trips, and Facilitating Efficient Trip Chains through Polycentric Development	Reid Ewing Yehua Dennis Wei Shima Hamidi	UU UTA	Complete
	An Electric Bus Deployment Framework for Improved Air Quality and Transit Operational Efficiency *	Xiaoyue Liu Aaron Golub Ran Wei	UU PSU UCR	Complete
	Connected Vehicle System Design for Signalized Arterials	Xianfeng Yang Mingyue Ji	UU	Complete
	Revisiting TODs: How Subsequent Development Affects the Travel Behavior of Residents in Existing Transit-Oriented Developments	Nathan McNeil Jennifer Dill	PSU	Complete
	Optimizing Housing and Service Locations to Provide Mobility to Meet the Mandated Obligations for Former Offenders to Improve Community Health and Safety*	Anne Nordberg Jaya Davis Stephen Mattingly	UTA	Complete
	Land Use and Transportation Policies for a Sustainable Future with Autonomous Vehicles: Scenario Analysis with Simulations	Liming Wang Yao-Jan Wu	PSU UA	Active (Final Report Pending)
	Emerging Technologies and Cities: Assessing the impacts of new mobility on cities	Becky Steckler Rebecca Lewis	UO	Complete
	LRT/BRT/SCT/CRT Development Outcomes FINAL PHASE	Arthur C. Nelson Kristina Currans Nicole Iroz Elardo	UA	Complete
Small Starts	Urban Transportation System Flood Vulnerability Assessment with Special Reference to Low Income and Minority Neighborhoods*	Courtney Crosson	UA	Complete
	Promoting Environmental Justice Populations Access to Opportunities within Suburban Boomtowns: An Interdisciplinary, Mixed-Methods Approach to Addressing Infrastructure Needs*	Jandel Crutchfield	UTA	Complete
	Visual Exploration of Utah Trajectory Data and their Applications in Transportation	Nikola Markovich (UU)	UU	Complete
Pooled Fund	Applying an Equity Lens to Automated Payment Solutions for Public Transportation*	Aaron Golub Jenny Liu John MacArthur Anne Brown	PSU	Complete

Grant	Project Title	Investigators	Univ.	Status
		Candace Brakewood	UO UTK	
	Exploring Data Fusion Techniques to Derive Bicycle Volumes on a Network	Sirisha Kothuri Joseph Broach Nathan McNeil Kate Hyun Stephen Mattingly Krista Nordback	PSU UTA UNC	Complete

*Research projects that address equity related to mobility

Table 4: Round 3 Research Projects funded by NITC in 2019

Grant	Project Title	Investigators	Univ.	Status
General Research	Is Transit-Oriented Development Affordable for Low and Moderate Income Households (in terms of H+T)?*	Reid Ewing Arlie Adkins Nicole Iroz-Elardo	UU UA	Complete
	Seamless Wayfinding by Individuals with Functional Disability in Indoor and Outdoor Spaces: An Investigation into Lived Experiences, Data Needs, and Technology Requirements*	Martin Swobodzinski Amy Parker	PSU	Complete
	New Mobility For All: Can Targeted Information And Incentives Help Underserved Communities Realize The Potential Of Emerging Mobility Options?*	Nathan McNeil John MacArthur Jennifer Dill	PSU	Complete
	Developing Strategies To Enhance Mobility And Accessibility For Community-Dwelling Older Adults*	Kate Hyun Caroline Krejci Kathy Lee	UTA	Complete
	Using Social Network Analysis To Optimize Access To Culturally Responsive And Affordable Transportation For Older (Im)Migrants*	Rebecca Mauldin Stephen Mattingly Rupal Parekh	UTA UTA UConn	Active
	Green Waves, Machine Learning, and Predictive Analytics: Making Streets Better for People on Bike & Scooter	Stephen Fickas	UO	Complete
	Rethinking Streets for COVID-19	Marc Schlossberg	UO	Complete
	Data-Driven Mobility Strategies for Multi-Modal Transportation	Yao-Jan Wu Sirisha Kothuri Xianfeng Yang	UA PSU UU	Complete
	Development Of Low-Cost Radar-Based Sensor For Multi-Modal Traffic Monitoring	Siyang Cao Yao-Jan Wu	UA	Complete

Grant	Project Title	Investigators	Univ.	Status
	Evaluation of Portland Shared E-Scooter Pilot Program Goals and Outcomes *	John MacArthur Jennifer Dill	PSU	Complete
	Scooting to a New Era in Active Transportation: Examining the Use and Safety of E-Scooters *	Kristina Currans Reid Ewing Nicole Iroz-Elardo	UA UU UA	Complete
Small Starts	Evaluating Mobility Impacts Of Construction Workzones On Utah Transportation System Using Machine Learning Techniques	Abbas Rashidi	UU	Complete
	Developing and Testing Transportation Barriers Scale and Its Impact on Mental Health Among At-risk/Homeless Youth and Emerging Adults *	Philip Baiden Godfred Boateng Stephen Mattingly	UTA	Complete
	Do Travel Costs Matter?: Using Psychological And Social Equity Perspectives To Evaluate The Effects Of A Low-income Transit Fare Program On Low-income Riders *	Liu-Qin Yang Aaron Golub Liming Wang	PSU	Complete
	E-Scooters and Public Health: Understanding the Implications of E-Scooters on Chronic Disease *	Nicole Iroz-Elardo	UA	Active (final report pending)
	The Impact of Ride Hail Services on the Accessibility of Nonprofit Services *	Dyana Mason	UO	Complete

*Research projects that include an equity focus related to mobility

Table 5: Round 4 Research Projects funded by NITC in 2020

Grant	Project Title	Investigators	Univ.	Status
General Research	Understanding Connections Between Mobility, Transportation, and Quality Of Life In Refugee Communities In Tucson, Arizona *	Orhon Myadar Arlie Adkins	UA	Active
	Data-Driven Optimization for E-Scooter System Design	Jianqiang Cheng	UA	Complete
	Understanding the Mobility Impacts of Decentralizing Homeless Services in Salt Lake County, Utah *	Sarah Canham Ivis Garcia	UU	Complete
	Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors *	Taylor Li Sirisha Kothuri	UTA PSU	Complete
	App-based Data Collection to Characterize Latent Transportation Demand within Marginalized and Underserved Populations *	Noelle Fields Courtney Cronley	UTA UTK	Active
	Mobility for the People: Evaluating Equity Requirements in Shared Mobility Programs *	Anne Brown Amanda Howell	UO	Complete

	Statistical Inference for Multimodal Travel Time Reliability	Avinash Unnikrishnan Miguel Figliozzi	PSU	Complete
	Estimating the Economic Impacts Of Transportation-Related Supply Chain Disruptions In The Post-Earthquake Environment	Divya Chandrasekhar	UU	Complete
	Marginalized Populations' Access to Transit: Journeys from Home and Work to Transit *	Marisa Zapata Miriam Abelson	PSU	Active
	Integrate Socioeconomic Vulnerability for Resilient Transportation Infrastructure Planning *	Liming Wang John MacArthur	PSU	Active (final report pending)
	Accessing Opportunities for Household Provisioning Post-COVID-19 *	Kelly Clifton Kristina Currans	PSU UA	Complete

*Research projects that address equity related to mobility

Table 6: Round 5 Research Projects

Grant	Project Title	Investigators	Univ.	Status
General Research	Rural Gentrification and the Spillover Effect: Integrated Transportation, Housing, and Land Use Challenges and Strategies in Gateway Communities *	Danya Rumore Philip Stoker	UU UA	Active
	Housing Choice, Transportation Equity, and Access to Opportunities in Refugee and Immigrant Communities *	Diane Mitschke	UTA	Active
	Assessing Cool Corridor Heat Resilience Strategies for Human-Scale Transportation *	Ladd Keith Kristina Currans Nicole Iroz-Elardo	UA	Active (final report pending)
	Exploring the Use of Crowdsourced Data Sources for Pedestrian Count Estimations	Sirisha Kothuri	PSU	Active
	Transportation for Seniors (T4S): Developing a New Accessibility Measure to Support Older Adults in a Post-Pandemic World *	Andy Hong Xiaoyue Cathy Liu	UU	Active
	Sustaining Multimodal Choices: Examining Travel Behavior for Non-work Trips Beyond COVID-19	Yizhao Yang Rebecca Lewis	UO	Active (final report pending)
	Towards Data and Solution-Focused Approaches to Support Homeless Populations on Public Transit *	Anne Nordberg	UTA	Complete
	How Can E-bike Purchase Incentives Grow the E-bike Market?	John MacArthur Christopher Cherry Luke Jones	PSU UT-K VSU	Complete

*Research projects that address equity related to mobility

Table 7: Translate Research to Practice Projects

Grant	Project Title	Investigators	Univ.	Status
Translate Research to Practice	Applying a Mt. Mazama Volcanic Ash Treatment as a Trail Accessibility Improvement	C.J. Riley Ashton Greer	OIT	Complete
	Using Maps and Online Tools to Operationalize Equity in Shared Mobility Services	Amanda Howell Anne Brown	UO	Complete
	Implementing a Community Transportation Academy	Nathan McNeil Keith Bartholomew	PSU UU	Complete
	Enabling Decision-Making in Battery Electric Bus Deployment through Interactive Visualization	Xiaoyue Cathy Liu Jianli Chen	UU	Complete
	Communicating Research through Comics: Transportation and Land Development	Kelly Clifton Kristina Currans	PSU UA	Complete
	Tools and resources for gateway communities	Danya Rumore	UU	Active
	Deploy LiDAR systems at intersections to improve equitable mobility	Taylor Li	UTA	Active

Table 8. Student group activities during this reporting period

Student group	Activity	Date	# of participants
STEP (PSU)	Career Exploration with Portland Bureau of Transportation	11/1/22	36
	Speaker Meeting with DKS	11/15/22	13
	Oregon ITE Traffic Bowl	11/17/22	4
	Speaker Meeting Kittelson	11/29/22	17
	TRB	1/8/23	12
	TRB Aftershock Presentation	1/30/23	23
	Western District ITE Traffic Bowl	2/11/23	3
	STEP Information Sharing and Board Elections	2/28/23	19
	Speaker Meeting and Careers with KPFF	3/2/23	12
ITE (OIT)	ITE Fall BBQ and Recruitment Night	10/19/22	84
	Oregon ITE Traffic Bowl (live in Portland)	11/17/22	8
	Pre TRB Organization Meeting	12/1/22	9
	Asphalt Pavement Association of Oregon annual meeting	12/2/22	3
	TRB Annual Meeting (Washington. DC)	1/7/23	9
	ITE Asphalt Keychain event	2/20/22	34
	ITE Transportation Game Night	2/22/22	23
	ITE Presents Jefferson Horn,Kiewit Infrastructure	3/8/22	21
Live Move (UO)	LiveMove Kick-off	10/10/22	40
	Public Event featuring Gil Peñalosa	11/03/22	60
	Course speaker: Gil Peñalosa	11/03/22	125
ITE (UTA)	Big Data for Transportation Planning, Josh Peterman	10/6/2022	12
	Road Safety on Five Continents	10/10/2022	29
	Traffic Incident Management in Connection with Road to Zero, Muhammad Musa	10/25/2022	12
	Development of a Roadside LIDAR Based Vehicle Intrusion Alerting System for Work zones, Minh Le	11/15/2022	12
	TRB's annual meeting in DC	01/08/23	9
	HDR Engineering at a Glance, Jory Dille, Nick Samuelson	1/24/2023	12
	Navigating Professional Life as an EIT	2/23/2022	12
	TexITE Fort Worth Joint Session	3/15/2023	40
Point B (UU)	Point B Lecture Series: Jason Wheeler & Roger Borgenicht	01/30/2023	23
	Point B: Office visits to David Evans	03/03/2023	7
	Point B: Funventure on Frontrunner	02/11/2023	9
	Point B: Lecture Series: Women in Transportation	02/27/2023	34
	Point B Lecture Series: Ped & Bike Planning	03/20/2023	29
UA	Gulsah Akar, Chair of the School of City and Regional Planning,	2/24/23	40

Student group	Activity	Date	# of participants
STEP (PSU)	Career Exploration with Portland Bureau of Transportation	11/1/22	36
	Speaker Meeting with DKS	11/15/22	13
	Oregon ITE Traffic Bowl	11/17/22	4
	Speaker Meeting Kittelson	11/29/22	17
	TRB	1/8/23	12
	TRB Aftershock Presentation	1/30/23	23
	Western District ITE Traffic Bowl	2/11/23	3
	STEP Information Sharing and Board Elections	2/28/23	19
	Speaker Meeting and Careers with KPFF	3/2/23	12
ITE (OIT)	ITE Fall BBQ and Recruitment Night	10/19/22	84
	Oregon ITE Traffic Bowl (live in Portland)	11/17/22	8
	Pre TRB Organization Meeting	12/1/22	9
	Asphalt Pavement Association of Oregon annual meeting	12/2/22	3
	TRB Annual Meeting (Washington. DC)	1/7/23	9
	ITE Asphalt Keychain event	2/20/22	34
	ITE Transportation Game Night	2/22/22	23
	ITE Presents Jefferson Horn,Kiewit Infrastructure	3/8/22	21
Live Move (UO)	LiveMove Kick-off	10/10/22	40
	Public Event featuring Gil Peñalosa	11/03/22	60
	Course speaker: Gil Peñalosa	11/03/22	125
ITE (UTA)	Big Data for Transportation Planning, Josh Peterman	10/6/2022	12
	Road Safety on Five Continents	10/10/2022	29
	Traffic Incident Management in Connection with Road to Zero, Muhammad Musa	10/25/2022	12
	Development of a Roadside LIDAR Based Vehicle Intrusion Alerting System for Work zones, Minh Le	11/15/2022	12
	TRB's annual meeting in DC	01/08/23	9
	HDR Engineering at a Glance, Jory Dille, Nick Samuelson	1/24/2023	12
	Navigating Professional Life as an EIT	2/23/2022	12
	TexITE Fort Worth Joint Session	3/15/2023	40
Point B (UU)	Point B Lecture Series: Jason Wheeler & Roger Borgenicht	01/30/2023	23
	Point B: Office visits to David Evans	03/03/2023	7
	Point B: Funventure on Frontrunner	02/11/2023	9
	Point B: Lecture Series: Women in Transportation	02/27/2023	34
	Point B Lecture Series: Ped & Bike Planning	03/20/2023	29
	Georgia Institute of Technology "Determinants of Sustainability - Mobility Patterns Among Older Adults"		

Student group	Activity	Date	# of participants
STEP (PSU)	Career Exploration with Portland Bureau of Transportation	11/1/22	36
	Speaker Meeting with DKS	11/15/22	13
	Oregon ITE Traffic Bowl	11/17/22	4
	Speaker Meeting Kittelson	11/29/22	17
	TRB	1/8/23	12
	TRB Aftershock Presentation	1/30/23	23
	Western District ITE Traffic Bowl	2/11/23	3
	STEP Information Sharing and Board Elections	2/28/23	19
	Speaker Meeting and Careers with KPFF	3/2/23	12
ITE (OIT)	ITE Fall BBQ and Recruitment Night	10/19/22	84
	Oregon ITE Traffic Bowl (live in Portland)	11/17/22	8
	Pre TRB Organization Meeting	12/1/22	9
	Asphalt Pavement Association of Oregon annual meeting	12/2/22	3
	TRB Annual Meeting (Washington. DC)	1/7/23	9
	ITE Asphalt Keychain event	2/20/22	34
	ITE Transportation Game Night	2/22/22	23
	ITE Presents Jefferson Horn,Kiewit Infrastructure	3/8/22	21
Live Move (UO)	LiveMove Kick-off	10/10/22	40
	Public Event featuring Gil Peñalosa	11/03/22	60
	Course speaker: Gil Peñalosa	11/03/22	125
ITE (UTA)	Big Data for Transportation Planning, Josh Peterman	10/6/2022	12
	Road Safety on Five Continents	10/10/2022	29
	Traffic Incident Management in Connection with Road to Zero, Muhammad Musa	10/25/2022	12
	Development of a Roadside LIDAR Based Vehicle Intrusion Alerting System for Work zones, Minh Le	11/15/2022	12
	TRB's annual meeting in DC	01/08/23	9
	HDR Engineering at a Glance, Jory Dille, Nick Samuelson	1/24/2023	12
	Navigating Professional Life as an EIT	2/23/2022	12
	TexITE Fort Worth Joint Session	3/15/2023	40
Point B (UU)	Point B Lecture Series: Jason Wheeler & Roger Borgenicht	01/30/2023	23
	Point B: Office visits to David Evans	03/03/2023	7
	Point B: Funventure on Frontrunner	02/11/2023	9
	Point B: Lecture Series: Women in Transportation	02/27/2023	34
	Point B Lecture Series: Ped & Bike Planning	03/20/2023	29
	Jesus M. Barajas, UCDavis, "Equity in Project Prioritization and Planning at State and Regional Transportation Agencies"	3/17/23	40

Table 9. List of publications resulting from work funded by NITC.

Publication citations (alphabetical by author) and DOIs	# of Citations
Peer-reviewed Journals (scientific, technical, or professional)	
Adkins, A., Barillas-Longoria, G., Martinez, D. N., & Ingram, M. (2019). Differences in social and physical dimensions of perceived walkability in Mexican American and non-hispanic white walking environments in Tucson, Arizona. Journal of Transport & Health, 14. , doi:10.1016/j.jth.2019.100585	28
Canham, S. L., Rose, J., Jones, S., Clay, A., & García, I. (2022). Community perspectives on how decentralising an emergency shelter influences transportation needs and use for persons experiencing homelessness. Health & Social Care in the Community, 30(6), e6645-e6655., https://doi.org/10.1111/hsc.13994	1
Chen, Z., Liu, X. C., & Wei, R. (2019). Agent-based approach to analyzing the effects of dynamic ridesharing in a multimodal network. Computers Environment and Urban Systems, 74, 126-135, https://doi.org/10.1016/j.compenvurbsys.2018.10.004	18
Chowdhury, F. R., Wang, P. S., & Li, P. T. (2023). Developing a tracking-based dynamic flash yellow arrow strategy for permissive left-turn vehicles to improve pedestrian safety at intersections. Journal of transportation engineering, Part A: Systems, 149(4), 04023017.,	0
Clark, B. Y. (2020). THE IMPACTS OF AUTONOMOUS VEHICLES ON LOCAL GOVERNMENT BUDGETING AND FINANCE: CASE OF SOLID WASTE COLLECTION. National Tax Journal, 73(1), 259-281., doi:10.17310/ntj.2020.1.08	4
Clark, B. Y., & Brown, A. (2021). What does ride-hailing mean for parking? Associations between on-street parking occupancy and ride-hail trips in Seattle. Case Studies on Transport Policy, 9(2), 775-783, doi:10.1016/j.cstp.2021.03.014	8
Dai, Z., Liu, X. C., Chen, Z., Guo, R. Y., & Ma, X. L. (2019). A predictive headway-based bus-holding strategy with dynamic control point selection: A cooperative game theory approach. Transportation Research Part B-Methodological, 125, 29-51. , doi:10.1016/j.trb.2019.05.001	33
Davis, J. B., Nordberg, A., Mattingly, S., Patel, M., & Leat, S. R. Transportation Among Returning Citizens: "You Just Want to Stay Down and Get High". International Journal of Offender Therapy and Comparative Criminology,	0
Deitz, S., Lobben, A., & Alferez, A. (2021). Squeaky wheels: Missing data, disability, and power in the smart city. Big Data & Society, 8(2), doi:10.1177/20539517211047735	9
Dill, J., & McNeil, N. (2022). Transit and Active Transportation Use for Non-Commute Travel Among Portland Transit-Oriented Development Residents. Transportation Research Record, 03611981221098391., 10.1177/03611981221098391	0
Ewing, R., Kim, K., Sabouri, S., Siddiq, F., & Weinberger, R. (2021). Comparative Case Studies of Parking Reduction at Transit-Oriented Developments in the USA. Transportation Research Record, 2675(1), 125-135, doi:10.1177/0361198120965558	2
Findley, E., & Crutchfield, J. Accessibility of transportation to child-welfare involved parents and the related impact on court-ordered service participation. Child & Family Social Work, doi:10.1111/cfs.12900	2
García, I., Albelson, M., Puczkowskyj, N., Khan, S. M., & Fagundo-Ojeda, K. (2022). Harassment of low-income women on transit: a photovoice project in Oregon and Utah. Transportation research part D: transport and environment, 112, 103466., https://doi.org/10.1016/j.trd.2022.103466	1
Gehrke, S. R., & Wang, L. M. (2020). Operationalizing the neighborhood effects of the built environment on travel behavior. Journal of Transport Geography, 82. , doi:10.1016/j.jtrangeo.2019.102561	23
Haghighi, N. N., Liu, X. C., Wei, R., Li, W. W., & Shao, H. (2018). Using Twitter data for transit performance assessment: a framework for evaluating transit riders' opinions about quality of service. Public Transport, 10(2), 363-377. , doi:10.1007/s12469-018-0184-4	51

Publication citations (alphabetical by author) and DOIs	# of Citations
Hemphill, R., MacArthur, J., Longenecker, P., Desai, G., Nie, L., Ibarra, A., & Dill, J. (2022). Congested sidewalks: The effects of the built environment on e-scooter parking compliance. Journal of Transport and Land Use, 15(1), 481-495., https://doi.org/10.5198/jtlu.2022.2110	2
Hinners, S. J., Nelson, A. C., & Buchert, M. (2018). Streetcars and Economic Development: Do Streetcars Stimulate Employment Growth? Transportation Research Record, 2672(8), 339-350. , doi:10.1177/0361198118790096	6
Iroz-Elardo, N., & Currans, K. Injury Burden of Introducing E-Scooters: A Review of E-Scooter Injury Studies Using Retrospective Review of Emergency Department Records, 2015-2019. Transportation Research Record, doi:10.1177/0361198121032216	8
Iroz-Elardo, N., Adkins, A., & Ingram, M. (2021). Measuring perceptions of social environments for walking: A scoping review of walkability surveys. Health & Place, 67, doi:10.1016/j.healthplace.2020.102468	17
Iuliano, J. E. (2022). Where and how Tucsonans ride and implications for cycling infrastructure. Cogent Social Sciences, 8(1), 2054127., https://doi.org/10.1080/23311886.2022.2054127	1
Karimpour, A., Anderson, J. C., Kothuri, S., & Wu, Y. J. Estimating pedestrian delay at signalized intersections using high-resolution event-based data: a finite mixture modeling method. Journal of Intelligent Transportation Systems, doi:10.1080/15472450.2021.1926246	8
Keeling, K. L., Glick, T. B., Crumley, M., & Figliozzi, M. A. (2019). Evaluation of Bus-Bicycle and Bus/Right-Turn Traffic Delays and Conflicts. Transportation Research Record, 2673(7), 443-453., doi:10.1177/0361198119849063	7
Kim, J. Y., Bartholomew, K., & Ewing, R. (2020). Another one rides the bus? The connections between bus stop amenities, bus ridership, and ADA paratransit demand. Transportation Research Part a-Policy and Practice, 135, 280-288. , doi:10.1016/j.tra.2020.03.019	14
Leat, S. R., Ravi, K. E., Nordberg, A., & Schrag, R. V. (2022). Exploring the feasibility of shared mobility services for reducing transportation disadvantage among survivors of intimate partner violence. Journal of Transport & Health, 27, 101517., https://doi.org/10.1016/j.jth.2022.101517	0
Lee, K., Cassidy, J., Mauldin, R. L., Parekh, R., Miyawaki, C. E., Ngo, H., ... & Nguyen, K. N. (2022). Recruitment and Data Collection Challenges of Research Focused on Older Adults and Family Caregivers from Asian American Communities: A Case Study Series. Clinical Gerontologist, 1-15., 10.1080/07317115.2022.2130848	0
Lee, S., & Wang, L. (2022). Intermediate Effect of the COVID-19 Pandemic on Prices of Housing near Light Rail Transit: A Case Study of the Portland Metropolitan Area. Sustainability, 14(15), 9107., https://doi.org/10.3390/su14159107	1
Lievanos, R. S., Lubitow, A., & McGee, J. A. (2019). Misrecognition in a Sustainability Capital: Race, Representation, and Transportation Survey Response Rates in the Portland Metropolitan Area. Sustainability, 11(16). , doi:10.3390/su11164336	4
Lubitow, A., Tompkins, K., & Feldman, M. (2019). Sustainable Cycling For All? Race and Gender-Based Bicycling Inequalities in Portland, Oregon. City & Community, 18(4), 1181-1202. , doi:10.1111/cico.12470	32
Lyons, T., & Choi, D. A. (2021). Transit Economic Equity Index: Developing a Comprehensive Measure of Transit Service Equity. Transportation Research Record, 2675(3), 288-300, doi:10.1177/0361198120970529	4
Mashhadi, A. H., Farhadmanesh, M., Rashidi, A., & Markovic, N. Review of Methods for Estimating Construction Work Zone Capacity. Transportation Research Record,	9
Maxwell, D., Mauldin, R., Thomas, J., & Holland, V. (2022). American Indian Motherhood and Historical Trauma: Keetoowah Experiences of Becoming Mothers. International Journal of Environmental Research and Public Health, 19(12), 7088., 10.3390/ijerph19127088	1
Miah, M. M., Hyun, K. K., Mattingly, S. P., & Khan, H. (2022). Estimation of daily bicycle traffic using machine and deep learning techniques. Transportation, 1-54., doi:10.1007/s11116-022-10290-z	0

Publication citations (alphabetical by author) and DOIs	# of Citations
Miah, M. M., Hyun, K. K., Mattingly, S. P., Broach, J., McNeil, N., & Kothuri, S. (2022). Challenges and Opportunities of Emerging Data Sources to Estimate Network-Wide Bike Counts. Journal of Transportation Engineering Part a-Systems, 148(3), doi:10.1061/jtepbs.0000634	3
Miller, S., Vander Laan, Z., & Markovic, N. (2020). Scaling GPS trajectories to match point traffic counts: A convex programming approach and Utah case study. Transportation Research Part E-Logistics and Transportation Review, 143, doi:10.1016/j.tre.2020.102105	10
Miller, V. J. (2019). Investigating Barriers to Family Visitation of Nursing Home Residents: A Systematic Review. Journal of Gerontological Social Work, 62(3), 261-278. , doi:10.1080/01634372.2018.1544957	22
Miller, V. J. (2020). The experience of transportation to visit a Nursing home resident: a case study. Social Work in Health Care, 59(5), 300-321. , doi:10.1080/00981389.2020.1756556	3
Nahar, S., & Cronley, C. Transportation Barriers among Immigrant Women Experiencing Intimate Partner Violence. Transportation Research Record, doi:10.1177/0361198121100458 7	4
Nelson, A. C. (2017). Transit and Real Estate Rents. Transportation Research Record, 2651(1), 22-30., https://journals.sagepub.com/doi/abs/10.3141/2651-03	8
Nelson, A. C. (2017). Transit-Oriented Developments Make a Difference in Job Location. Fordham Urb. LJ, 44, 1079.,	8
Nelson, A. C., Stoker, P., & Hibberd, R. (2019). Light rail transit and economic recovery: A case of resilience or transformation? Research in Transportation Economics, 74, 2-9. , doi:10.1016/j.retrec.2018.11.003	8
Nordberg, A., Davis, J. B., Patel, M., Mattingly, S., & Leat, S. R. Towards a Reentry Mobilities Assemblage: An Exploration of Transportation and Obligation Among Returning Citizens. Mobilities, doi:10.1080/17450101.2021.2008770	1
Park, K., Ewing, R., Sabouri, S., Choi, D. A., Hamidi, S., & Tian, G. Guidelines for a Polycentric Region to Reduce Vehicle Use and Increase Walking and Transit Use. Journal of the American Planning Association, 14., doi:10.1080/01944363.2019.1692690	42
Park, K., Sabouri, S., Lyons, T., Tian, G., & Ewing, R. (2020). Intrazonal or interzonal? Improving intrazonal travel forecast in a four-step travel demand model. Transportation, 47(5), 2087-2108, https://doi.org/10.1007/s11116-019-10002-0	14
Parker, A. T., Swobodzinski, M., Brown-Ogilvie, T., & Beresheim-Kools, J. (2020). The Use of Wayfinding Apps by Deafblind Travelers in an Urban Environment: Insights From Focus Groups. Frontiers in Education, 5, doi:10.3389/feduc.2020.572641	3
Parker, A. T., Swobodzinski, M., Wright, J. D., Hansen, K., Morton, B., & Schaller, E. (2021). Wayfinding Tools for People With Visual Impairments in Real-World Settings: A Literature Review of Recent Studies. Frontiers in Education, 6. , doi:10.3389/feduc.2021.723816	5
Sabouri, S. (2021). Assessing polycentric development in terms of trip chaining efficiency. Cities, 117, doi:10.1016/j.cities.2021.103300	0
Sabouri, S., Tian, G., Ewing, R., Park, K., & Greene, W. (2021). The built environment and vehicle ownership modeling: Evidence from 32 diverse regions in the US. Journal of Transport Geography, 93, doi:10.1016/j.jtrangeo.2021.103073	7
Sleep, MD and Masley, M, (2019) Innovative and Sustainable Uses of Volcanic Ash as a Natural Pozzolan for Dust Abatement and Unpaved Roadway Improvement, Eighth International Conference on Case Histories in Geotechnical Engineering, March 24–27, 2019, Philadelphia, PA, https://ascelibrary.org/doi/10.1061/9780784482148.023	2
Smith, C., Myadar, O., Iroz-Elardo, N., Ingram, M., & Adkins, A. (2022). Making of home: Transportation mobility and well-being among Tucson refugees. Journal of Transport Geography, 103, 103409., https://doi.org/10.1016/j.jtrangeo.2022.103409	0
Swobodzinski M, Parker AT, Wright JD, Hansen K and Morton B (2021) Seamless Wayfinding by a Deafblind Adult on an Urban College Campus: A Case Study on Wayfinding Performance, Information Preferences, and Technology Requirements. Front. Educ. 6:723098. , doi: 10.3389/feduc.2021.723098	1

Publication citations (alphabetical by author) and DOIs	# of Citations
Tan, H., McNeil, N., MacArthur, J., & Rodgers, K. (2021). Evaluation of a Transportation Incentive Program for Affordable Housing Residents. Transportation Research Record, 2675(8), 240-253., doi:10.1177/0361198121997431	4
Wang, P. R., Li, P. F., & Chowdhury, F. R. (2022). Development of an Adaptive Traffic Signal Control Framework for Urban Signalized Interchanges Based on Infrastructure Detectors and CAV Technologies. Journal of Transportation Engineering Part a-Systems, 148(4). , doi:10.1061/jtepbs.0000648	2
Wang, Q. Z., Yang, X. F., Huang, Z. T., & Yuan, Y. (2020). Multi-Vehicle Trajectory Design During Cooperative Adaptive Cruise Control Platoon Formation. Transportation Research Record, 2674(4), 30-41. , doi:10.1177/0361198120913290	12
Wang, Q. Z., Yang, X., & Yuan, Y. (2021). Dynamic Multipath Signal Progression Control Based on Connected Vehicle Technology. Journal of Transportation Engineering Part a-Systems, 147(10), doi:10.1061/jtepbs.0000565	1
Wei, Y. D., Xiao, W. Y., & Wu, Y. Y. (2021). Trip generation, trip chains and polycentric development in metropolitan USA: A Case Study of the Wasatch Front Region, Utah. Applied Geography, 133, doi:10.1016/j.apgeog.2021.102488	5
Wei, Y. D., Xiao, W. Y., Medina, R., & Tian, G. Effects of neighborhood environment, safety, and urban amenities on origins and destinations of walking behavior. Urban Geography. ,	8
Wu, Y. Y., Wei, Y. D., & Li, H. (2020). Firm Suburbanization in the Context of Urban Sprawl: Neighborhood Effect and Sectoral Difference. Professional Geographer, 72(4), 598-617. , doi:10.1080/00330124.2020.1750437	14
Wu, Y. Y., Wei, Y. H. D., & Li, H. (2020). Analyzing Spatial Heterogeneity of Housing Prices Using Large Datasets. Applied Spatial Analysis and Policy, 13(1), 223-256., doi:10.1007/s12061-019-09301-x	35
Xiao, W. Y., & Wei, Y. D. (2021). Multiscale Analysis of Urban Walkability and Pedestrian's Destination Choice. Journal of Urban Planning and Development, 147(1), doi:10.1061/(asce)up.1943-5444.0000638	6
Yang, H. (2022). Assessing the Effects of New Light Rail Transit on Regional Traffic Congestion and Transit Ridership: A Synthetic Control Approach. IEEE Transactions on Intelligent Transportation Systems., doi:10.1109/tits.2022.3168858	3
Yang, X. F., Chang, G. L., Zhang, Z., & Li, P. F. (2019). Smart Signal Control System for Accident Prevention and Arterial Speed Harmonization under Connected Vehicle Environment. Transportation Research Record, 2673(5), 61-71. , doi:10.1177/0361198119837242	14
Yang, X. T., Huang, K., Zhang, Z. H., Zhang, Z. A., & Lin, F. (2021). Eco-Driving System for Connected Automated Vehicles: Multi-Objective Trajectory Optimization. Ieee Transactions on Intelligent Transportation Systems, 22(12), 7837-7849, doi:10.1109/tits.2020.3010726	26
Yi, Z. Y., Liu, X. C., & Wei, R. (2022). Electric vehicle demand estimation and charging station allocation using urban informatics. Transportation Research Part D-Transport and Environment, 106. , doi:10.1016/j.trd.2022.103264	9
Zhang, Z., Yuan, Y., & Yang, X. (2020). A hybrid machine learning approach for freeway traffic speed estimation. Transportation research record, 2674(10), 68-78., doi:10.1177/0361198120935875	10
Zhang, Zhao, & Yang, Xianfeng. (2020). Freeway Traffic Speed Estimation by Regression Machine-Learning Techniques Using Probe Vehicle and Sensor Detector Data. Journal of Transportation Engineering, Part A, 146(12), Journal of transportation engineering, Part A, 2020-12-01, Vol.146 (12)., https://doi-org.proxy.lib.pdx.edu/10.1061/JTEPBS.0000455	11
Zhou, Y. R., Liu, X. C., Wei, R., & Golub, A. (2021). Bi-Objective Optimization for Battery Electric Bus Deployment Considering Cost and Environmental Equity. Ieee Transactions on Intelligent Transportation Systems, 22(4), 2487-2497, doi:10.1109/tits.2020.3043687	20

Publication citations (alphabetical by author) and DOIs	# of Citations
Peer-reviewed published proceedings of conferences & meetings (# citations not available)	
Sleep, MD and Masley, M, (2019) Innovative and Sustainable Uses of Volcanic Ash as a Natural Pozzolan for Dust Abatement and Unpaved Roadway Improvement, Eighth International Conference on Case Histories in Geotechnical Engineering, March 24–27, 2019, Philadelphia, Pennsylvania	Published
Nelson, Arthur C. and Keuntae Kim. 2018. Bus Rapid Transit and Economic Development: A Quasi-Experimental Treatment and Control Analysis. Meeting Compendium of Papers. Transportation Research Board.	Published
Nelson, Arthur C. and Robert Hibberd. 2018. Analysis of the Variation in Apartment and Office Market Rents with Respect to Commuter Rail Transit Station Distance in Metropolitan San Diego and Salt Lake City. Meeting Compendium of Papers. Transportation Research Board.	Published
Nelson Arthur C. et al. 2018. *Commuter Rail Transit and Economic Development*. Meeting Compendium of Papers. Transportation Research Board.	Published
Nelson, Arthur C. 2018. Express Busways and Economic Development: Case Study of the Miami-Dade South Express Busway. Meeting Compendium of Papers. Transportation Research Board.	Published
Hinners, Sarah Jack, Arthur C. Nelson, Martin Buchert. 2018. Streetcars and Equity: Case Studies of Four Streetcar Systems Assessing Change in Jobs, People and Gentrification. Annual Meeting Compendium of Papers. Transportation Research Board.	Published
Hibberd, Robert and A.C. Nelson. 2018. *Longitudinal Cluster Analysis of Jobs-Housing Balance in Transit Neighborhoods*. Meeting Compendium of Papers. Transportation Research Board.	Published
Nelson, Arthur C. and Robert Hibberd. 2018. Using the Real Estate Market to Establish Streetcar Catchment Areas: Case Study of Multifamily Residential Rental Property in Tucson, Arizona. Meeting Compendium of Papers. Transportation Research Board.	Published
Nelson, Arthur C. 2018. Bus Rapid Transit and Office Rents. Annual Meeting Compendium of Papers. Transportation Research Board.	Published

Table 10: Organizations partnering with NITC projects.

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
AARP Oregon	Oregon				x[1,4]
AARP Utah	Utah				x[1]
Agape Clinic	Dallas, TX		x		
Alliance for Walking and Biking	Washington, DC				x[1]
American Planning Association-Idaho	Boise, ID	x			
American Printing House for the Blind	Louisville, KY		x		
Arlington Adult Day Health Care	Arlington, TX		x		
Asian Pacific American Network of Oregon	Portland, OR		x		
Assoc. of Pedestrian Bicycle Prof.	Lexington, KY	x			x[1]
Catholic Charities Archdiocese of Hartford	Hartford, CT		x	x	
Catholic Charities of Fort Worth	Fort Worth, TX		x		
Central Lane MPO	Eugene, OR	x			
City of Arlington	Arlington, TX		x		
City of Aspen	Aspen, CO		x		
City of Eugene	Oregon	x			x[1]
City of Gresham	Oregon	x			
City of Irving	Irving, TX		x		x[1,4]
City of Moab	Moab, UT		x		
City of Orem	Orem, Utah	x			
City of Portland	Oregon		x		x[1]
City of Seattle	Washington		x		
City of Springfield	Oregon				x[1]
City of Tucson	Arizona	x	x		
City of Whitefish	Whitefish, MT	x	x		
CitySquare Transition Resource Action Center	Dallas, TX		x		
Clevor Consulting Group	Portland, OR	x			
Colorado Association of Ski Towns	Dillon, CO		x		
Colorado DOT	Denver, CO	x			
Community Action Committee	Knoxville, TN				x[2]
Community Builders	Glenwood Springs, CO		x		
Concord Engineering	Utah	x			
Dallas Area Rapid Transit (DART)	Dallas, TX		x		
District of Columbia DOT	Washington, DC	x			

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
ECONorthwest	Portland, OR	x			
Gayle Wells Foundation	Houston, TX		x		
Greenlining Institute	Oakland, CA		x		
Institute for Sustainable Solutions	Portland, OR	x			
John S. and James L. Knight Foundation	Miami, FL	x			
Lane Transit District	Eugene, OR	x			
League of American Cyclists	Washington, DC				x[1]
Living Streets Alliance	Tucson, AZ				x[4]
Metro	Portland, OR	x	x		
Metropia	Tucson, AZ		x	x	
Mid-American Regional Council	Kansas City, MI	x			
Mountainland Assoc. of Gov't	Orem, UT			x	
moovel NA	Portland, OR	x			x[1]
Multnomah County	Portland, OR				x[1,4]
Oregon DOT	Salem, OR	x	x		x[1]
OPAL Environmental Justice	Portland, OR				x[1]
PeopleforBikes	Boulder, CO	x			
Pima County DOT	Arizona	x			
Portland Metro	Portland, OR	x	x		x[1,4]
Project 7B	Utah	x	x	x	
Puget Sound Regional Council	Washington				x[1]
RAHOK	Pasadena, CA		x		
Regional Disaster Preparedness Organization	Portland, OR			x	
Regional Transportation Commission of Southern NV	Nevada	x			
Regional Transportation Council	Dallas-Fort Worth, TX				x[1]
Regional Transportation District	Denver, CO	x			x[1]
Resource Systems Group (RSG)	Salt Lake City, UT			x	
Rowell Brokaw Architects	Eugene, OR	x	x		x[2]
Salt Lake City Corporation	Salt Lake City, UT	x	x		
Salt Lake County Planning & Transp.	Salt Lake City, UT	x			
Sixty and Better	Fort Worth, TX		x		
Smart Growth America	Washington, DC				x[1]
South Tabor Neighborhood Association	Portland, OR		x		x1
St. George Area Convention and Tourism	Washington County, UT	x	x	x	

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
State Fair of Texas/Big Tex	Dallas, TX		x		
Streetlight Data Inc.	San Francisco, CA			x	
The Road Home	Salt Lake City, UT		x		
The Senior Source	Dallas, TX		x		
Town of Springdale	Utah	x	x	x	
TriMet	Portland, OR			x	x[1,2]
Tucson Water	Tucson, AZ		x		
Uber Eats	San Francisco, CA			x	x[1]
Unlimited Choices	Portland, OR				x[3]
Unlocking Doors	Dallas, TX		x		
Utah Commission on Aging	Utah				x[1]
USTAR - Utah Office of Economic Development	Salt Lake City, UT	x			
Utah Division of Emergency Management	Utah		x		
Utah Inland Port Authority	Utah		x		
Utah Office of Tourism	Utah	x	x	x	
Utah DOT	Salt Lake City, UT	x		x	x[1]
Utah Transit Authority	Salt Lake City, UT	x		x	
Virginia DOT	Richmond, VA	x			
Volunteers of America, Utah	Salt Lake City, Utah		x		
Wasatch Front Regional Council	Salt Lake City, UT	x		x	x[1]
Washington County Engineering & Construction Services	Hillsboro, OR			x	
Washington Department of Transportation	Olympia, WA				x[1]

[1]Resource partner (provides input into research at various stages of project)
[2]Assistance with data collection and/or processing
[3]Recruitment of survey participants
[4]Facilitates communication with stakeholders.

Table 11. Technology Transfer Performance Metrics

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
Outputs	Number of final reports 38 total	Produce final report that clearly articulate research results and meet NITC standards (KPI: 1 final report/project) On track
	Number of publications in trade/professional publications 56	Meet or exceed the number of publications (KPI: 1 publication/project) On track
	Number of presentations at national/ international and professional/trade conferences 27 last six months	Meet or exceed the number of presentations (KPI: 1 presentation/project) On track
	Number of events and event participants for technology transfer 15 events past 6 months average 78 attendees/event	Meet or exceed number of events, professional development hours and number of attendees (KPI: 25 number of events/year with average of 50 attendees/event) Exceed
	Number of dissemination tools and products for recently completed research projects 6 briefs 3 webinars	Meet or exceed the number of dissemination tools or products per project (KPI: 1 brief/project) On track
	Number of downloads for electronic tools (databases, scripts, algorithms, etc.) 637 downloads of 10 datasets	Meet or exceed the downloads per electronic tool (KPI: 20 downloads/tool) On track
	Number of media stories covering NITC faculty, researchers and projects 21 in the last six months	Meet or exceed the number of media stories (KPI: 30/year) On track
	Percentage increase in online engagement with new stakeholders: NITC Newsletter (subscribers) - 0% NITC Twitter - 11% Facebook - 2% YouTube - 9% LinkedIn - 27% Instagram - 7% Ongoing performance of online engagement NITC Newsletter (open rate) - 20% NITC Newsletter (click-through rate) - 19.9% NITC Website (# of site visitors) - 15,506	Meet or exceed our currently high averages for online engagement metrics (KPI: 10% or greater increase in new stakeholders across platforms -and- Meet or exceed baseline for ongoing online engagement NITC Newsletter (open rate) - 18.7% NITC Newsletter (click-through rate) - 19.5% NITC Website (# of site visitors) - 10,900 per 6 months On track
Outcomes	Number of stakeholders who collaborated on implementing research outcomes 10 stakeholders	Meet or exceed the number of stakeholders involved (KPI: TBD) In progress. Two is the baseline.

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
	Number of projects that reach deployment and adoption. 20 projects	Meet or exceed number of projects that reach TRL scale 4-5 (KPI: TBD) In progress. Six is the baseline.
Impacts	Number of stakeholders reporting impact from surveys Practitioners 44 Faculty/Researchers 17 Students 9 Other stakeholders 26	Meet or exceed response rate of stakeholders. (KPI: surveys) On track
	Number of stakeholders who have adopted, implemented or deployed research findings or technologies: 50	Meet or exceed number of adoptions, implementations and deployments (KPI: surveys) On track