UTC-Semi-Annual Progress Report

Portland State University

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Table of Contents

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 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 73 research projects through General Research (57), Small Starts (14) and Pooled-Fund grants (2). The General Research grant program supports larger-scale projects. The Small Starts grant program funds researchers who have not yet had the opportunity to undertake significant transportation research. All projects have to be consistent with NITC's theme, are peer reviewed, and are selected by the NITC Executive Committee via consensus. During this reporting period, there were 38 active projects, of which 8 were completed.

Build and extend existing research through Year 1 projects.

The 10 Initial Research Projects funded by NITC (close to $2 million) engage 22 researchers. Seven projects involved more than one partner university, demonstrating our commitment to collaboration. The projects are, on average, 95% complete. (Appendix, Table 1). Six projects are complete, and their final reports are available online.

Competitive, peer-review project selection process in Years 2-5.

General Research: In August 2021, seven proposals were selected from 29 total proposals for funding through the fifth General Research RFP (Appendix, Table 6). In October, an additional proposal was selected for funding using unspent funds from a previous project by the same PI. The awards range from $44,963 to $75,000 for a total of $530,419 in NITC funding. The funding request of all proposals was $1,955,716. One of the projects is evaluating the application of "cool pavement" in Tucson, AZ, and their work was featured on the local NBC affiliate - KVOA on Dec 15, 2021.

In July 2020, 11 proposals were selected out of 43 total proposals for funding through the fourth General Research RFP (Appendix, Table 5). The awards ranged from $67,619 to $147,448 for a total of $1,142,665 in grant funding. The funding request of all proposals was $4,562,006. Their research progress was significantly affected by the COVID-19 pandemic. Two of the projects were completed during this period; on average, the projects are 86% complete.

In June 2019, ten proposals were selected out of 37 total proposals for funding through the third General Research RFP (Appendix, Table 4). The selection process included prioritization for projects relating to multimodal transportation data and transportation, land-use, housing interactions. The awards ranged from $53,702 to $145,650 for a total of $1,035,794 in grant funding. The funding request of all proposals was $3,803,378. Seven of the projects are complete, including four during this period, and their final reports are available online. On average, the projects are 95% complete. These projects were significantly affected by the COVID-19 pandemic.

In June 2018, eleven proposals were selected for funding through the second General Research RFP (Appendix, Table 3). These projects ranged from $38,049 to $149,973 for a total of $925,578. Ten of the projects are complete, including one during this period, and the other one is 96% complete.

The first RFP for General Research was issued in spring 2017. Six projects were selected, ranging from $39,932 to $99,764, for a total of $437,762 (Appendix, Table 2). These projects are fully complete, and their final reports are available online.

Small Starts: For the third round, five proposals were selected for total funding of $99,916 in November 2019. Their progress was slowed by the COVID-19 pandemic; but three are complete and their final reports are available online. Overall, they are 95% complete. In 2018, three Small Starts projects were awarded $60,000 in funding (Appendix, Table 3). They are all complete. In 2017, six Small Starts projects were funded. Project budgets were approximately $20,000, for a total of $119,924 (Appendix, Table 2). Five projects are complete, and the one still active is 85% complete.

Transportation for Livable Communities Pooled Fund Research

NITC's Pooled Fund program 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. In January 2019, two Pooled Fund Projects were awarded $350,000 in funding from 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 their final reports are available online.

1.2.2 Leadership

High Standing within National and International Arenas of Transportation

- Jennifer Dill (PSU) was one of four invited framing speakers at the TRB-FHWA Emerging Trends Symposium, speaking on "Transportation Investments: Alignment with Trends & Needs." Each year, The Transportation Research Board (TRB) and the Federal Highway Administration (FHWA) hold an Emerging Trends Symposium, giving FHWA the chance to hear from people with knowledge and expertise on a topic of FHWA's choosing.
- Miguel Figliozzi won the Award for Best Research Paper at the Transportation Research Board (TRB) Annual Conference for his paper entitled "Modeling Optimal Drone Courier Fleet Size and Sustainability Tradeoffs." This award is given annually to the research paper that best advances the discussion of urban freight movement.
- In March, Chris Monsere (PSU) was awarded the Branford Price Millar Award For Faculty Excellence, the top award for any faculty at PSU. The Branford Price Millar Award is given annually to a faculty member in a tenure-track or tenured appointment who has demonstrated excellence in the areas of scholarship, instruction, university service and public service, and whose performance in the area of scholarship and research is judged to be exceptional. Monsere's primary research interests are in the design and operation of multimodal transportation facilities including user behavior, comprehension, preferences, and the overall safety effectiveness of transportation improvements. He has received research funding through NITC, as well as the Oregon DOT and NCHRP. The results of his research have been cited in federal guidance and been used as evidence for interim approval in the Manual of Uniform Traffic Control Devices (MUTCD).

Solving Regional and National Transportation Problems

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

- In February, Urbanism Next Center Director Nico Larco (UO) testified during the congressional hearing, "The Road Ahead for Automated Vehicles" highlighting the potential cascading impacts of autonomous vehicles.
- Jennifer Dill (PSU) was quoted in a February 10, Bloomberg article "With Bike Buses, Kid Cyclists Dominate the Road" on the dual benefits of bike buses, which "create a safe environment for kids and they are a great way to raise visibility for cycling infrastructure."
- Yao-Jan Wu (UA) became director of the Center for Applied Transportation Sciences (CATS) within the College of Engineering. The center works with local agencies to encourage technology transfer of affiliated-CATS transportation projects to the community.

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. Of the 73 research projects, only two do not directly support students, and 42 (58%) support untenured, tenure-track faculty.

- Thirty-one students were supported to attend the annual Transportation Research Board conference in Washington, D.C. (Actual attendance was less because of cancellations due to rising cases of COVID-19.)
- Kelly Rodgers (PSU), member of TRB's Transportation and Public Health Committee, was a lead organizer of the workshop: Do you count if you're not counted? An exploration of systematic bias in our crash data systems, impacts on vulnerable road users, and implications for research and practice. She is a NITC Dissertation Fellow, the vice-chair of the Institute of Transportation Engineers' Health and Transportation Standing Committee, and an advisory board member of the American Public Health Association's Center for Climate, Health, and Equity.
- University of Utah Ph.D. student Zhao Zhang and his advisor Xianfeng Yang were awarded the 2021 Best Dissertation Award from the TRB Standing Committee on Artificial Intelligence and Advanced Computing Applications (AED50) at TRB's Annual Meeting in January. The title of the dissertation is "Modeling Freeway Traffic Flows with Hybrid Machine Learning."
- Ash Avila (UA), a 2022 TRB Minority Student Fellow, presented a poster at TRB on "The Effect of Vehicles on Personal Heat Exposure: A Pilot Study". A junior in the Sustainable Built Environment undergraduate program at UA, Ash is working on analyses related to exploring transportation infrastructure and environmental influences of thermal comfort and evaluating some potential mitigations. She is also working with NITC researchers Ladd Keith, Nicole Iroz-Elardo and Kristina Currans on the intersection of transportation and heat as it relates to climate adaptation planning.
- Avinash Unnikrishnan, previous NITC Executive Committee member for PSU and PI on a current research project, earned the 2021 - 2023 Wedge Vision Professorship for mid-career tenured faculty who are making significant efforts to advance the strategic vision and core values of the Maseeh College of Engineering and Computer Science.

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	**Reporting period**	**All-time**
Final reports	3,194	19,558
Project briefs	3,968	17,593
Webinars (views)	2,558	12,776
Datasets	184	689
Total	9,783	49,922

Downloads of final reports from project websites require downloaders to provide their email address, which NITC uses to request feedback. During this period, 64 people completed surveys on NITC reports: 26 practitioners, 18 faculty/researchers, 13 students, and 7 other stakeholders. Twenty-seven of

the respondents indicated that they downloaded the report to help make decisions about practice. They heard about the reports from: NITC newsletter 30%, web searches 39%, TRB/TRID search 20%, and colleagues 11%. Eighty-eight percent of them rated the reports as very or somewhat useful, with 77% saying the reports met their needs, and 94% 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. The student groups have significantly increased their activities this academic year.

- NITC supports student groups on each of our partner campuses. Under the guidance of an Executive Committee member, each group is able to set its own agenda and priority to cater to its unique student body, goals, and interests. NITC student groups made a significant comeback as in-person activities on campuses have resumed. During this reporting period, a total of 53 meetings/events were attended by 648 student group participants (Appendix, Table 8).
- This year, UO's student group, LiveMove, is analyzing the potential for developing a Neighborhood Greenway along a stretch of road in Eugene and presented design recommendations to the city transportation staff. Neighborhood Greenways redesign roads to become welcoming for all modes of transport, emphasizing walking and biking and lowering vehicle speeds. The potential of this street to include a greenway would provide a connective alternative to a major arterial road that services a high volume of commuter traffic for individuals living in the surrounding neighborhoods. The road is also connected to a popular recreational path, which would further integrate active transport connections in this area of the city and introduce an alternative route that would avoid a busy and traffic heavy four-way intersection for bicyclists and pedestrians, especially children attending the nearby schools.
- PSU architecture and UO landscape architecture design studios collaborated on designing light rail stations for TriMet's "Better Red" extension project.
- PSU's civil engineering senior capstone course is working with community partners in: Hood River, OR to create a safe neighborway for children, parents and community members to access school, parks and other local amenities by walking, biking and rolling; the City of Independence's Neighborhood Greenways to design a low-stress biking and walking network connecting local schools, businesses, and parks; and Portland's Parkrose neighborhood to create a pathway, which will increase access to green space and community knowledge, to the Columbia Slough.
- The UA Masters of Urban and Regional Planning studio course is working with the City of Tucson to develop a scenario analysis for their Broadway corridor. Anticipating some type of high-capacity transit, the Broadway corridor provides a real-world learning experience considering the relationship between transportation, development, and environmental impacts.
- PSU's ITE-STEP co-hosted a virtual TRB Aftershock Event with Young Professionals in Transportation (YPT) where Portland State University representatives shared their TRB-presented research with a local audience. At the end of January, the PSU ITE-STEP Chapter registered 9 students for the virtual Western District Student Leadership Summit (SLS) hosted by San Jose State University. In February, they held an advocacy forum with speakers from BikeLoud, No More Freeways, Oregon Walks, Parking Reform Network, and Participatory Budgeting Oregon. An advocacy night in late March featured the Street Trust discussing their 501(c)(3) non-profit community fund and 501(c)(4) political action fund.

Develop Innovative New Curriculum and Learning Opportunities.

UA's Craig M Berge Engineering Design Program, directed by Larry Head, engages all senior engineering students in a capstone course and complete design projects. Several of this year's 83 industry sponsored projects are transportation related.

Educate Professionals

During the reporting period, NITC supported 23 events that were attended by 1,906 professionals: 5 NITC webinars attended by 431 individuals (primarily practitioners), 14 Friday Transportation Seminars attended, virtually, by 1,171 people (mostly practitioners), two Transportation Data webinars (160 attendees), and two workshops on Transportation Resilience and Recovery in the Portland/Vancouver Region (144 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. Viewers streamed our events from all over the United States, Canada, and several other countries. Each of these events are one-hour long and attendees may receive one AICP professional development credit. During this period, APA awarded practitioners 3,562 AICP credits, and the practitioners rated TREC's events 3.9 out of 5 stars. Since 2000, the events have a 4.0 out of 5 rating from 12,517 reviews. Attendees must fill out an evaluation form to receive their AICP credit, and we use this feedback to improve future events.

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.

- A NITC Education project at UTA, led by Joowon Im, engaged 30 CityLab High School students in a month-long GIS Lab Course to better understand the relationships among transportation planning and design, community improvement, and environmental justice along the Trinity River. The project concluded with a presentation on March 3 and an exhibition of the students' work at the Architecture and Design Exchange in Dallas, TX.
- During this period, NITC awarded scholarships to five undergraduate students and travel awards to three undergraduate students to attend the TRB conference, and 17 undergraduate students participated in NITC research projects.
- UA undergraduate student Ash Avila, a 2022 TRB Minority Student Fellow, is a NITC Student Scholar working with UA faculty on a NITC project studying engineered pavements coatings – known as "cool pavement" - that reflect light and therefore heat to reduce the thermal load of roads.

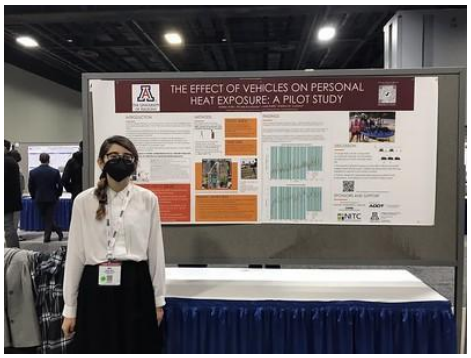

Figure 1: UA student Ash Avila at the 2022 TRB Annual meeting

Attract and Support Graduate Students.

NITC awarded scholarships to 23 Master's and 2 Ph.D. students, and travel funds for conferences to 2 Master's and 9 Ph.D students. NITC offers dissertation fellowships to Ph.D. students who have advanced to candidacy. This reporting period, NITC's Executive Committee awarded a dissertation fellowship to Austin Drukker, UA, for "How Essential is Essential Air Service? A Welfare Analysis of Airport Access for Remote Communities."

Kelly Rodgers, PSU Ph.D. student in Urban Studies who is studying the use and influence of health indicators in transportation plans, was named NITC's UTC Outstanding Student of the Year. NITC provides two additional annual awards in order to recognize master's and Ph.D. students. Darshan Chauhan, a Ph.D. Candidate in Civil and Environmental Engineering and Graduate Research Assistant at

PSU, was named NITC PhD Student of the Year. His doctoral work with Avinash Unnikrishnan is on planning and real-time resource allocation in freight logistics systems using robust optimization and reinforcement learning. Apy Das, a recent masters graduate of the Department of Civil and Environmental Engineering at PSU and Transportation Engineer at the Washington State Department of Transportation, was named Master's Student of the Year.

1.2.4 Technology Transfer

Move Research into Practice.

NITC created a new funding opportunity, Translate Research to Practice, for researchers to build on previous NITC projects' accomplishments, strengthen partnerships with transportation agencies and community organizations, and produce outputs for practitioners. Last summer and fall, NITC awarded five projects for a total of $297,223 (Appendix, Table 7).

One of the projects funded used results from a previously funded NITC project that documented the curriculum and impacts of Portland's Traffic and Transportation course–a city-university partnership in free education for community members. Keith Barthlomew (UU) teamed up with Nathan McNeil (PSU) to apply this learning model in the Salt Lake region of Utah. They developed and implemented an eight-week pilot course, the Wasatch Transportation Academy, to help thirty community members understand how the transportation system works, particularly around how and where they can get involved in the different steps of the transportation planning process. Students gained the transportation background, knowledge and tools to understand and participate in planning processes and discussions. Students engaged in topics that they are interested in and developed a deeper understanding of transportation decision making processes. It is hoped that this expanded skill set can, over time, empower students to serve as ambassadors to other interested community members. Ultimately, the course seeks to increase the number of Wasatch Front residents who are comfortable engaging on the topic of transportation, both directly through course graduates, and indirectly through the people they interact with in the community. The course was directly inspired by Portland's Traffic and Transportation course that, since the early 1990s, has taught over 1,200 community members.

Figure 2: Students from the Wasatch Transportation Academy

Use Innovative Approaches to Communicate Research Results.

In a positive shift since the last reporting period, visitors and engagement has grown across all social media platforms, the NITC website, and our newsletters. Updated daily, the NITC website saw 16,454 site visitors during this reporting period. This was a 26.5% increase from the last period. Our highest engagement with U.S. web visitors by state is as follows: Washington, Oregon, California, Wyoming, Texas, and Virginia.

We published twenty-four 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 6,193 subscribers (27% open rate; 13.9% click-through rate) dedicated to communicating NITC research and events.

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. 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 will include 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. The six roadmaps were funded at $50,000 each for a total of $300,000 with 1:1 matching funds.

NITC also encourages our consortium faculty to collaborate on research projects. Of the 73 research projects funded to date, 43% (31) involve more than one consortium partner, and 57% (41) of the research projects included investigators from more than one discipline.

John MacArthur (PSU) is working with Jandel Crutchfield (UTA) on developing an Introduction to Racial Equity and Social Justice for Transport Planners and Engineers course that will be tested by faculty across NITC campuses. The course material will consist of a flexible module approach and resources to be used in existing introduction-level engineering and planning courses, at both the undergraduate and graduate levels, to provide content on the topic.

Collaborating with other UTCs.

NITC shared with Amanda Collamore, Transportation Infrastructure Durability Center (TIDC) Program Coordinator, the codebase for the Proposal and Project Management System database in order to help them meet the USDOT reporting requirements. Amanda was referred to NITC by Carnegie Mellon University's Mobility21/Traffic21, which has been using a modified version of the PPMS database.

External collaboration

During this period, NITC Advisory Board members were involved in reviewing and providing feedback on the Research Roadmap draft reports. In addition to serving on the board, several work for organizations that provide matching funds and collaboration on NITC research projects.

NITC researchers Sirisha Kothuri, Christopher Monsere, and Nathan McNeil (PSU) partnered with Paul Ryus (Kittelson & Associates), and UNC's Highway Safety Research Center research to update pedestrian analysis methodologies in the Highway Capacity Manual (HCM).

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. Alejandro Hukill-Arias (UTA), a student that worked on the project Using Social Network Analysis To Optimize Access To

Culturally Responsive And Affordable Transportation For Older (Im)Migrants, reflected, "This opportunity gave me a closer look at the administrative side of research projects. Additionally, it opened up my view of working in research, in general. In the past, I have not seen myself as someone who would go into research work. I never considered that working on translating documents would be part of research work. In the least, working on this project gave me exposure to different roles within research that I never even considered."

Priority funding to research with an equity focus.

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. Some examples of the work on advancing understanding of equity from active research projects are:

- creating mapping tools with accessible information for planners and policymakers to craft micromobility policies that are centered on equitable mobility outcomes;
- exploring how transit does, or does not, meet the needs of people experiencing homelessness;
- and promoting the coordination of transportation planning and affordable housing.

Additional activities that advance equity

NITC has been working to operationalize equity into our programs encouraging these types of activities across our campuses.

- Anne Brown (UO) is developing curriculum resources to engage students in key equity considerations and questions that travel behavior patterns present to transportation professionals. Curriculum resources will engage students with the existing modal investments along with barriers and dynamics that shape travel behavior. The course will approach travel behavior as both a cause and result of transportation inequity. Student discussions and an in-class activity will challenge students to grapple with the role of transportation professionals in delivering more equitable transportation in the future.
- PSU integrated transportation equity topics into the Friday Seminar Series and was intentional about ensuring that not only the topics but guest speakers are diverse (e.g., gender, race, background, perspectives, etc.)
- PSU's student group hosted an online book group to expand their understanding of transportation. Twenty students, faculty, and staff participated, read and discussed *Bicycle/Race: Transportation, Culture, & Resistance* by Adonia E. Lugo. Dr. Lugo presented at a follow up seminar about her book and transportation justice.

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 6,193 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?

Expected highlights for the next reporting period include:

- Reporting on completion and progress of active research projects
- Reporting on student events and activities
- Updates on tech transfer and workforce development activities, including the completion of six research roadmaps

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 92 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?

UTA researchers collaborated with Christina Melton Crain, the founder of Unlocking Doors in Dallas, Texas to identify opportunities to support the reentry of former offenders by improving their mobility of their clients. "From the outset, when [the research team] came to us and approached us about being their partner on this project, we were so excited because transportation is one of the key barriers for our population that we serve," said Christina Melton Crain. They created a simple graphical user interface (GUI) for the staff at Unlocking Doors to input their clients' locations and receive a list of feasible locations in return. "If I'm able to put in where a guy resides… and it's going to populate for me all the different service providers that are available, the different employers that are available, in either a walkable or easy public transportation spectrum – or even on a bicycle – then we're doing great. I think this is really going to be a game changer for us. We're very excited about it," Melton Crain said.

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-one 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 307 times (86 times during this reporting period). Research is also published in conference proceedings (Appendix, Table 9). NITC has published 38 final reports, with one-page project briefs for each final report.

- On February 9, five PSU researchers presented their NITC-supported research to TransPort, which is a forum for cooperative planning and deployment, wherein transportation systems engineers and planners represent regional agencies (Oregon Department of Transportation, TriMet, Metro, Clackamas County, Multnomah County, Washington County and the City of Portland).

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: 3,982 followers, +98): 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. Launched in 2019, our NITC_UTC twitter 595 followers, +68) offers more effective framing of the consortium partnership.

- Facebook (1,082 followers, +12): In addition to sharing research, this platform shares photos of our events and offers connections with other organizations, researchers, and practitioners.
- YouTube (1,080 subscribers, +70): Where we publish freely accessible video recordings of weekly seminars at PSU, monthly NITC webinars, special lectures, student spotlights and more.
- LinkedIn (842 followers, +183): 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 (685 followers, +33): 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 events that were attended by 2,236 professionals: 7 NITC and transportation data webinars (591 attendees), 14 Friday Transportation Seminars (1,171 attendees), and 2 workshops on Regional Transportation Resilience Investments and Plans (144 attendees). These events are eligible for AICP professional development credit.

Mobility Matters 2022, a half-day virtual summit at PSU on March 4, brought together 290 participants to explore the topics of climate change, inclusive transportation, and public space design for and with people with disabilities. One participant noted, "The topics were diverse enough to challenge the way I think about mobility and familiar enough for me to understand the wonky topics that were covered. It is also inspiring to see examples of practitioners advancing accessibility in transportation." Another noted, "I got more value out of this half day conference than I've gotten in many days of other kinds of training - and I feel renewed in my commitment to working on disability and mobility justice issues!"

3.4 Technologies or techniques

One of the outputs of the How Can E-bike Purchase Incentives Grow the E-bike Market? (John MacArthur, PSU) project is an online database of e-bike incentive programs, which has been shared with policymakers. This policy tool has been used to help create e-bike incentive programs across the country. In Fall 2021, the Chair of the Monterey County Board of Supervisors successfully used MacArthur's e-bike white papers to advocate for a brand new e-bike incentive program that will serve low income residents from three counties on the California Central Coast. Through their regional Air Resources Board they are offering a $1,000 incentive for the purchase of an e-bike. "Your work to establish the value of e-bikes was tremendously valuable as I fought to gain support for a local program," shared Board Chair Wendy Root Askew.

The continued partnership between NITC researchers Amy Parker and Martin Swobodinski with GoodMaps, a startup born out of the American Printing House for the Blind, has resulted in PSU becoming one of the first spaces in the Pacific Northwest to be outfitted with an app that uses scanning technology to map buildings in detail, and provide wayfinding for users that are blind or visually impaired.

On a recently concluded NITC project, Anne Nordberg (UTA) and her research team used a mix of qualitative and quantitative methods to create three mathematical applications to optimize housing and service locations in their own metro area of Dallas/Fort Worth, Texas. Through a simple graphical user interface, the staff at Unlocking Doors are able to input their clients' locations and receive a list of feasible locations in return. This will optimize housing and service provider locations to ease transportation burdens on former offenders.

PSU's BikePed Portal - bicycle and pedestrian management system - now provides Average Annual Daily Traffic (AADT) volumes for locations across the country. This builds on previous research on the accuracy of methods and directly incorporates the estimation methods from the Federal Highway Administration 2016 Traffic Monitoring Guide. Bicycle and pedestrian volumes are used in planning for active transportation projects.

Based on work from a previous NITC grant, Dr. Sean Barbeau (University of South Florida) and his team created an open-source software tool that aims to improve the quality of real-time information for travelers by validating data shared by transit agencies in the General Transit Feed Specification (GTFS) Realtime format. The tool has been deployed by both the French National Access Point to Transport Data (Point d'Accès National) for France as well as the California Integrated Travel Project (Cal-ITP) for California. Both organizations have created data portals for their respective jurisdictions and have integrated the GTFS Realtime validator into their data pipelines. These data portals allow transit providers in France and California, respectively, to easily review reports on their transit data quality and work with vendors and their own staff to quickly fix errors in their data.

Transportation agencies can use cameras to monitor traffic modes, but they are limited in rainy, dark or foggy conditions. Using radar, which works better in low-visibility, is an alternative but it doesn't provide as rich a picture of what's going on or differentiate between modes reliably. Through NITC project "Development of Intelligent Multimodal Traffic Monitoring using Radar Sensor at Intersections", researchers Siyang Cao, Yao-jan Wu, Feng Jin and Xiaofeng Li (UA) have tackled the issue by developing a high-resolution radar sensor that can reliably distinguish between cars and pedestrians. This sensor also supplies the counts, speed, and direction of each moving target, no matter what the lighting and weather are like.

3.5 Inventions, patent applications, and/or licenses

N/A

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: 9
   They included: Salt Lake City Corporation; The Road Home; Volunteers of America, Utah; City Square Transition Resource Action Center; City of Orem, Utah; ECONorthwest; The Senior Source; City of Tucson; and Unlocking DOORS.

2. Number of projects that reach deployment and adoption (measured by the number of projects that reach TRL scale 4 or 5): 9.
   Additionally, we have identified 7 projects that we believe will reach TRL scale of 4 or 5.

Attracting and retaining undergraduate and graduate students outcomes

- Three students from NITC-funded campuses earned prestigious awards from the Portland chapter of WTS:
    - Caroline Schulze (OIT) received the Sharon D. Banks Memorial Undergraduate Scholarship

    - Cynthia Roe (OIT) received the Gail Achterman Leadership Scholarship for Graduate or Undergraduate
    - Caroline Crisp (PSU) received the Beverley Swaim Leadership Legacy Scholarship for Graduates
- Glenn Ingram's (UA '23 MS Urban Planning) "New York City 100-Year Floodplain" map was selected as the Best Student Map among all collegiate entries at the 2021 Arizona Geographic Information Council Maps & Apps Contest.
- Eight students from the six NITC campuses were awarded Dwight David Eisenhower Transportation Fellowships: Cameron Bennett, PSU; Brendan Irsfeld, UO; Adrian Cottam, UA; and Abhinav Awasthi, Juana Perez, Nice Kaneza, Erica Robinson, and Basleal Takele, UTA.
- Thomas Dodgen and Caroline Schulze, OIT, earned scholarships from the Asphalt Pavement Association of Oregon (APAO) Educational Foundation. OIT maintains a decades-long relationship with APAO and the Oregon asphalt pavements industry. APAO was instrumental in establishing the Oregon Tech Pavement Engineering Lab in Cornett Hall.
- Caroline Schulze (OIT) was awarded the Oregon Institute of Transportation Engineers (ITE) undergraduate scholarship.
- Dr. Joey Iuliano (UA), NITC dissertation fellow who earned his Ph.D. in 2021, published a journal article in the March 2022 issue of Cogent Social Sciences: Where and how Tucsonans ride and implications for cycling infrastructure. He is currently a lecturer at UA.
- Bailey Homan, NITC scholar and undergraduate research assistant for UA's Center for Applied Transportation Sciences, was elected student President of the UA Women in Civil Engineering chapter for 2021-2023.

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. Forty-four 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).

- Number of stakeholders reporting impact (from surveys): 27 this period; 116 total
- Number of stakeholders who have adopted, implemented or deployed research findings or technologies: 12 this period; 44 overall

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

A city planner in Columbus, Ohio used the report from the project Understanding Economic and Business Impacts of Street Improvements for Bicycle and Pedestrian Mobility to inform the public input process about a project: "We're working on a project to add bike lanes to a street with on-street parking and many small businesses. [The project includes] researching economic impacts of bike lanes on businesses." Collaborating with PeopleForBikes and Bennett Midland, the research team studied the economic effects of bicycle infrastructure on 14 corridors across six U.S. cities — Portland, Seattle, San Francisco, Memphis, Minneapolis and Indianapolis. They found that improvements on bicycle and

pedestrian infrastructure had either positive or non-significant impacts on the local economy as measured through sales and employment.

Specific examples of practitioners using the results of NITC funded research projects include:

- USDOT used data on bicycle travel speeds collected from NITC-funded research to help update their Benefit-Cost Analysis Guidance for Discretionary Grant Programs.
- One specific use of "Fast Track: Allowing Bikes to Participate in a Smart Transportation System" research was to analyze this application for Corvallis's traffic signal operations. "We decided that the field results from a one or two year period would be required to determine how it may apply to our community's needs."
- The City of Milwaukie, OR will be updating/revising their Transportation Safety Plan starting in 2022, including the bicycle and pedestrian section. This practitioner noted, "I downloaded this document "Lessons from the Green Lanes: Evaluating Protected Bike Lanes in the U.S." to provide ideas and information for myself and the community stakeholders group I will be working with."

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?

John MacArthur's (PSU) continued work on e-bike policy and collaboration with other UTCs (UNC, UC Davis, and University of Tennessee, Knoxville) along with external partners Vision Zero SF Injury Prevention Research Collaborative and American College of Surgeons, Committee on Trauma, Injury Prevention and Control committee led to the update of the ICD-10-CM (injury codes) to include e-bikes in the definitions. Previously, e-bikes were not listed and more than likely classified as a motorcycle. It took two tries to get them to be integrated with the CDC anticipating implementation of the e-bicycle codes on October 1, 2022.

The results of the NITC project "The Use of Mt. Mazama Volcanic Ash as Natural Pozzolans for Sustainable Soil and Unpaved Road Improvement" were used to inform market availability within Oregon as the Oregon Department of Transportation is looking for cement alternatives.

Applying NITC's research that investigated racial bias at the crosswalk, the Seattle Department of Transportation will compare the percentage of people driving who stop for white pedestrians to the percentages of those who stop for pedestrians who are Black, Indigenous, and/or people of color. This is part of a new public education campaign around Vision Zero.

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, one respondent cited "New Mobility For All: Evaluation of a Transportation Incentive Program for Residents of Affordable Housing in Portland, OR" in literature review of technical recent research in shared mobility. Another used a NITC research final report, Narratives of Marginalized Cyclists: Understanding Obstacles to Utilitarian Cycling Among Women and Minorities in Portland, OR, to help design their own qualitative study.

The impact can also be made beyond transportation. A student used the report on ADA Accessible Trail Improvement with Naturally Occurring, Sustainable Materials for a discussion post for an undergraduate course in the Plant Biology Department of the University of Georgia.

Amy Lubitow (PSU) and Kyla Tompkins (graduate student), and Madeleine Feldman '17 wrote a 2019 article, "Sustainable Cycling For All? Race and Gender-Based Bicycling Inequalities in Portland, Oregon,"

based on NITC funded research. This was listed as one of the top-10 most downloaded articles of 2021 by the American Sociological Association.

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. Since the last reporting period, we received feedback from 1,095 webinar / seminar participants where over 81% noted that the purpose for attending was professional development; with 89.5% indicated that the training met their purposes. One participant commented, "These seminars are consistently the most high quality trainings I attend. I really appreciate being able to tune in remotely."

PSU held a transportation seminar specifically on the transportation workforce "Retention of a Diverse Construction Workforce" focused on Maura Kelly's research on inequalities in the construction trades and advocates to increase opportunities for women and people of color in the trades. Feedback from participants on how they expect to use what they learned include,

- "[I] will look for opportunities in my organization to encourage more measures for supporting women/BIPOC in construction."
- "Ensure any contractor I hire has respectful workplace training for their workers/works to encourage a diverse workforce and hire apprentices."
- "I will look further into Rise Up & continue my company's work on bystander training."
- "Develop tools and resources to address harassment on the construction worksites."

Skills and knowledge for current workforce

The monthly NITC webinars provide researchers with an opportunity to present their research to planners, engineers, researchers, students, and members of the public. Reid Ewing (UU) and second year Masters student Justyna Kaniewska presented on their NITC 1328 project "Is Transit-Oriented Development Affordable for Low and Moderate Income Households?" on Feb 15, 2022 to 103 attendees. The analysis of housing costs revealed a lot of variability across different regions. Of all the examined housing developments, only 16 projects/developments out of 117 across 85 TOD sites were deemed 100% "affordable". Feedback from participants on how they expect to use what they learned included:

- "Our town is considering rezoning to allow more TOD and this webinar was great in providing pointers on what to consider and not to do."
- "I will discuss it with and refer my colleagues to it as we prepare cities a TOD opportunity report for the first BRT corridor in our Region."

Kate Hyun, Kathy Lee, and Caroline Krejci (UTA) presented their NITC 1304 project "Developing Strategies To Enhance Mobility And Accessibility For Community-Dwelling Older Adults"on Jan 26, 2022 to 124 attendees. They looked at the mobility challenges, barriers, and gaps that older adults experience, and strategies to fill those gaps. They also considered the impacts of COVID-19 on the health and travel behavior of older adults. They offer five key strategies ranging from public assistance programs, to door-to-door mobility, and reducing car dependence earlier in life through design and policy. Feedback from participants on how they expect to use what they learned include,

- "I am currently working on the demographics for the updated census tracts in a nearby county. Opportunity is our focus, so accessibility is very important. We're looking for trends in low-opportunity areas, and this webinar gave me a lot of ideas about things to consider and challenges to watch out for. I'd love to hear even more about Agent-based modeling and how to access and use these tools."
- "My job is to help communities implement active transportation (non-auto dependent) plans and systems in communities around our state. I found the information in this presentation very

valuable to help understand the needs of older adults, who are our largest growing sector of the population."

- "As I work with my local transit organization, it will help me keep in mind some of the barriers to use by older residents."
- "It helps me understand the challenges facing older adults that can help tailor my agency's provision of transportation services."

Next generation of leaders

PSU alumni Olivia Holden, TDM-CP, now Senior Manager of Programs at Commute Seattle, awarded as one of the 2021 ACT 40 under 40 for her work in transportation demand management.

A former student, who worked on the NITC project "Applying an Equity Lens to Automated Payment Solutions for Public Transportation" and is now working in public transit fare policy, has used the findings for public engagement and reference on banking and smartphone usage.

Next generation of faculty

In October, Anne Brown, Assistant Professor at UO and NITC researcher on several projects, won the 2021 Association of Collegiate Schools of Planning Rising Scholar Award.

Arlie Adkins was named interim director of UA's Transportation Research Institute.

Courtney Crosson was named Interim Director of the Drachman Institute, the outreach arm of the UA College of Architecture, Planning and Landscape Architecture.

6 CHANGES/PROBLEMS

6.1 Changes in approach and reasons for change

In-person activities resumed in Fall 2021, and a lot of work has been done to increase student group activities. We continue to offer online or hybrid options for many courses, events, and other activities.

6.2 Changes that have a significant impact on expenditures

There are so significant impacts on expenditures.

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

Researchers continue to face difficulties with human subjects data collection. They have been using online methods for surveys and interviews, and they are trying to resume some in-person data collection. Other researchers have used available datasets rather than collect their own data.

6.4 Change of primary performance site location from that originally proposed

NITC campuses have reopened for in-person teaching for Fall 2021 term.

7 SPECIAL REPORTING REQUIREMENTS

Not applicable.

4 APPENDIX

Table 1: Initial research projects funded (2016-2017)

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
	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	Active
	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

*Research projects that address equity related to mobility

Table 2: Research Projects funded by NITC in 2017

Grant	Project Title	Investigators	Univ.	Status
General Research (Round 1)	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
	Understanding Factors Affecting Arterial Reliability Performance Metrics	Avinash Unnikrishnan Sirisha Kothuri	PSU	Complete

Grant	Project Title	Investigators	Univ.	Status
	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 (Round 1)	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: Research Projects funded by NITC in 2018

Grant	Project Title	Investigators	Univ.	Status
General Research (Round 2)	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
	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

Grant	Project Title	Investigators	Univ.	Status
	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
	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 (Round 2)	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 Candace Brakewood	PSU UO UTK	Complete
	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: Research Projects funded by NITC in 2019

Grant	Project Title	Investigators	Univ.	Status
General Research (Round 3)	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	Active
	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	Active
	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
	Evaluation of Portland Shared E-Scooter Pilot Program Goals and Outcomes *	John MacArthur Jennifer Dill	PSU	Active
	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 (Round 3)	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	Active

Grant	Project Title	Investigators	Univ.	Status
	E-Scooters and Public Health: Understanding the Implications of E-Scooters on Chronic Disease *	Nicole Iroz-Elardo	UA	Active
	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: Research Projects funded by NITC in 2020

Grant	Project Title	Investigators	Univ.	Status
General Research (Round 4)	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	Active
	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	Active
	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	Processing final report
	Statistical Inference for Multimodal Travel Time Reliability	Avinash Unnikrishnan Miguel Figliozzi	PSU	Active
	Estimating the Economic Impacts Of Transportation-Related Supply Chain Disruptions In The Post-Earthquake Environment	Divya Chandrasekhar	UU	Active
	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
	Accessing Opportunities for Household Provisioning Post-COVID-19 *	Kelly Clifton Kristina Currans	PSU UA	Active

Table 6: Research Projects funded by NITC in 2021

Grant	Project Title	Investigators	Univ.	Status
General Research (Round 5)	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
	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
	Developing Data and Solution Focused Approaches to Support Homeless Populations on Dallas Area Rapid Transit (DART) *	Anne Nordberg	UTA	Active
	How Can E-bike Purchase Incentives Grow the E-bike Market?	John MacArthur Christopher Cherry Luke Jones	PSU UT-K VSU	Active

Table 7: Translate Research to Practice Projects funded by NITC in 2021

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	Active
	Using Maps and Online Tools to Operationalize Equity in Shared Mobility Services	Amanda Howell Anne Brown	UO	Active
	Implementing a Community Transportation Academy	Nathan McNeil Keith Bartholomew	PSU UU	Active
	Enabling Decision-Making in Battery Electric Bus Deployment through Interactive Visualization	Xiaoyue Cathy Liu Jianli Chen	UU	Active
	Communicating Research through Comics: Transportation and Land Development	Kelly Clifton Kristina Currans	PSU UA	Active

Table 8. Student group activities during this reporting period

Student group	Activity	Date	# of participants
STEP (PSU)	TRB Annual Meeting	1/9-1/13/22	11
	ITE Student Leadership Summit	1/28-1/30/22	9
	Transportation Game Night	1/19/22	18
	Book Club: Adonia E. Lugo's Bicycle/Race Transportation, Culture, and Resistance	2/11/22	25
	PBOT Speaker Meeting	2/16/22	15
	Transportation Advocacy Forum: BikeLoud, No More Freeways, Parking Reform, and Oregon Walks	2/22/22	15
	TRB Aftershock	2/23/22	13
	Kittelson and Associates Speaker Meeting	3/1/22	15
	STEP Leadership Board Elections	3/2/22	9
	Elcon Associates, Inc. & King County Metro Speaker Meeting	3/11/22	5
ITE (OIT)	Oregon ITE Traffic Bowl (virtual)	11/1/21	6
	ITE Student Chapter meeting	12/2/21	15
	TRB Annual Meeting	1/9-1/13/22	4
Live Move (UO)	9 Chapter meetings (~10 participants at each meeting)	weekly	90
	General Transportation Roundtable Discussion	10/21	10
	General Transportation Roundtable Discussion	11/21	14
	General Transportation Roundtable Discussion	1/22	12
	Speaker Series: Eugene Design on Transportation Spaces	2/17/22	10
	Speaker Series: Becky Steckler on Micromobility	2/22/22	10
	Induced Demand Roundtable Discussion	3/22	12
ITE (UTA)	Application of Human Factors in the Development of Geometry Design", ITE Guest Speaker	10/20/2021	22
	2021 ITS Texas / TexITE Joint Meeting	11/3/2021	3
	SMILE in Transportation: Culturally Responsive Teaching Through Transportation Concept ITE Guest Speaker	11/17/2021	17
	TRB Annual Meeting	1/9-1/13/22	5
Point B (UU)	TRB Annual Meeting	1/9-1/13/22	1
	Intersection Redesign Project-Kick Off Meeting	2/3/2022	6
	Intersection Redesign Project-Site Visit	2/18/2022	6
	Bike/Walk Provo	2/26/2022	8
	Intersection Redesign Project-Design Workshop	3/5/2022	5
	APA UT Spring Conference 2022	3/23/2022	10
UA	Dr. Hugo Zhou - Effects of Low Cost Countermeasures on Wrong-Way Driving (WWD) Indidents: Case Studies in Alabama	10/22/21	20

Student group	Activity	Date	# of participants
	Zirui (Raymond) Huang - Cooperative Demand Management Model Development and Solution Procedure for Large-Scale Freeway Systems	11/3/21	20
	Dr. Kristina Currans - Ubiquitously Incremental and Pernicious: The Dynamic Role of Parking Supply in Increasing Vehicle Use	11/5/21	20
	NITC Co-Sponsored Lecture: Charles Marohn - Public hybrid online	11/16/21	12
	NITC Co-Sponsored Lecture: Charles Marohn - Campus (public invited) hybrid online	11/17/21	10
	Dr. Alyssa Ryan - Unmanned Aerial Vehicles: Applications in Transportation and Driver Behavior Considerations	11/19/21	20
	Pramesh Pudasaini - Network-wide Mobility Assessment Procedure: A multi-criteria approach	11/23/21	20
	Arizona Institute for Resilience (AIR, Climate Action Planning) Lecture - Kathryn Logan	12/10/21	20
	TRB Annual Meeting	1/9-1/13/22	5
	Dr. Hasan Ozer - Advancing Materials and Design Strategies for Durable and Sustainable Pavements	2/4/22	20
	Xiaobo Ma - Eliminating the Impacts of Traffic Volume Variation on Before and After Studies	2/9/22	20
	Dr. Aleksandar Stevanovic - Place of Adaptive Traffic Control Systems in the US Traffic Signals Market – Where are we and where shall we go?	2/25/22	20
	Dr. Arlie Adkins - "The Criticality Of Context: Centering The Sociocultural In Planning And Urban Design Practice"	3/23/22	20
	John Penuelas, Senior Director of Engineering at the Regional Transportation Commission of Southern Nevada - State of art of different traffic signal control technologies in Nevada	3/25/22	20

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	14
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	13
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	4
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	23
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. doi:10.1177/0306624x211059476	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.	2
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	0
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	0
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	12
Haghighi, Nima, Xiaoyue Liu, Ran Wei, Wenwen Li, Hu Shao (2018). Using Twitter Data for Transit Performance Assessment: A Framework for Evaluating Transit Riders' Opinions about Quality of Service. Public Transport. Vol 10, Issue 2, pp 363-377. 2018 doi:10.1007/s12469-018-0184-4	34
Hinners, S. J., Nelson, A. C., & Buchert, M. (2018). Streetcars and Economic Development: Do Streetcars Stimulate Employment Growth?. Transportation Research Record. doi:10.1177/0361198118790096	6
Iroz-Elardo, N., & Currans, K. (2021) 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:10.1177/03611981211032216	1

Publication citations (alphabetical by author) and DOIs	# of Citations
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	3
Karimpour, A., Anderson, J. C., Kothuri, S., & Wu, Y. J. (2021) 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	2
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	3
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	9
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	2
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	16
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	3
Mashhadi, A. H., Farhadmanesh, M., Rashidi, A., & Markovic, N. (2021) Review of Methods for Estimating Construction Work Zone Capacity. Transportation Research Record. doi:10.1177/03611981211002202	5
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.	0
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	4
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	16
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	1
Nahar, S., & Cronley, C. Transportation Barriers among Immigrant Women Experiencing Intimate Partner Violence. Transportation Research Record	0
Nelson, Arthur C. (2017). Transit and Real Estate Rents, Transportation Research Record: Journal of the Transportation Research Board, Vol 2651(5), 22-30	7
Nelson, Arthur C. et al. (2017). Transit-Oriented Developments Make a Difference in Job Location, Fordham Urban Law Journal, Vol 44 (4), 1079-1102 doi:10.1016/j.retrec.2018.11.003	8

Publication citations (alphabetical by author) and DOIs	# of Citations
Nelson, A. C., Stoker, P., & Hibberd, R. (2018). Light rail transit and economic recovery: A case of resilience or transformation?. Research in Transportation Economics. https://journals.sagepub.com/doi/abs/10.3141/2651-03	5
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. (2020). 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	23
Park, K., Sabouri, S., Lyons, T. et al. (2019) Intrazonal or interzonal? Improving intrazonal travel forecast in a four-step travel demand model. Transportation. https://doi.org/10.1007/s11116-019-10002-0 https://doi.org/10.1007/s11116-019-10002-0	8
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	0
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	3
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	0
Tan, H. J., McNeil, N., MacArthur, J., & Rodgers, K. (2021) Evaluation of a Transportation Incentive Program for Affordable Housing Residents. Transportation Research Record. doi:10.1177/03611981219974 31	3
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:10.1109/tits.2020.3010726	0
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	4
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	0
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	0

Publication citations (alphabetical by author) and DOIs	# of Citations
Wei, Y. D., Xiao, W. Y., Medina, R., & Tian, G. (2021) Effects of neighborhood environment, safety, and urban amenities on origins and destinations of walking behavior. Urban Geography. doi:10.1080/02723638.2019.1699731	5
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	9
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	15
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	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	11
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.	7
Zhang, Z., Yuan, Y., & Yang, X. F. (2020). A Hybrid Machine Learning Approach for Freeway Traffic Speed Estimation. Transportation Research Record. doi:10.1177/0361198120935875	6
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	6
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	6
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

Publication citations (alphabetical by author) and DOIs	# of Citations
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 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			

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
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		
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			
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]

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
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]
St. George Area Convention and Tourism	Washington County, UT	x	x	x	
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		

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
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 51	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

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
	Number of events and event participants for technology transfer 23 events/last six months average 83 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) On track
	Number of dissemination tools and products for recently completed research projects 8 briefs 4 webinars 2 datasets	Meet or exceed the number of dissemination tools or products per project (KPI: 1 brief/project)
	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) In progress
	Number of media stories covering NITC faculty, researchers and projects 23 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) - 6% NITC Twitter - 13% Facebook - 1% YouTube - 7% LinkedIn - 28% Instagram - 5% Ongoing performance of online engagement NITC Newsletter (open rate) - 27% NITC Newsletter (click-through rate) - 13.9% NITC Website (# of site visitors) - 16,454	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 9 stakeholders	Meet or exceed the number of stakeholders involved (KPI: TBD) In progress. Two is the baseline.
	Number of projects that reach deployment and adoption. 9 projects	Meet or exceed number of projects that reach TRL scale 4-5 (KPI: TBD) In progress. Six is the baseline.

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
Impacts	Number of stakeholders reporting impact from surveys Practitioners 38 Faculty/Researchers 14 Students 12 Other stakeholders 25	Meet or exceed response rate of stakeholders. (KPI: surveys) In progress
	Number of stakeholders who have adopted, implemented or deployed research findings or technologies: 44	Meet or exceed number of adoptions, implementations and deployments (KPI: surveys) In progress