UTC-Semi-Annual Progress Report

Portland State University

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1 ACCOMPLISHMENTS: What was done? What was learned?

1.1 What are the major goals of the program?

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

Research

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

Leadership

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

Education and Workforce Development

- **Offer Degrees and Courses in Multiple Disciplines.** NITC university partners will continue to offer a rich array of degrees that serve the transportation profession.
- **Provide Experiential Learning.** Our campuses will continue to provide experiential learning opportunities, and NITC will seek ways to expand them.

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

Technology Transfer

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

Collaboration

- **Collaborate within our consortium.** Our governance structure is cooperative and leadership is distributed. The Executive Committee includes one faculty member from each campus, and it provides overall direction for the Center, makes project funding decisions, and selects NITC award recipients, including student of the year. They will meet in person at least once a year, rotating the location between campuses, and hold regular conference calls. Each Executive Committee member will be responsible for representing and supporting their respective campus.
- **Collaborate externally.** In addition to the partnerships that occur through individual projects and the pooled-fund program, NITC will foster collaboration with a range of "end-users" of our work through an External Advisory Board. As the national UTC for improving the mobility of people and goods, NITC will work with OST-R staff to foster collaboration between all the UTCs focusing on this DOT priority. Primary aims will be to avoid duplication of efforts and identify opportunities for collaboration.

Diversity

- **Attract underrepresented students to transportation careers**. We aim to attract underrepresented students to transportation through programs that target middle, high school, or elementary school students. We do this by providing funds to researchers who engage underrepresented students in their projects, collaborating with WTS, STEM and education experts,

and expanding our National Summer Transportation Institute (NSTI) Program to partner campuses.

- **Priority funding to research with an equity focus.** We give priority to funding research projects that have an equity focus by awarding them additional points in the RFP process.

1.2 What was accomplished under these goals?

1.2.1 Research

NITC has funded research through various grant competitions. The General Research grant program 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 are consistent with NITC's theme, peer reviewed, and are selected by the NITC Executive Committee via consensus. Of the 79 research projects funded, 57 are completed and 22 are active. There will likely be no additional research funded in the upcoming year as we work on closing out the grant.

Build and extend existing research through the initial year projects.

The ten initial Research Projects funded by NITC (close to $2 million) engage 22 researchers. Seven projects (Appendix, Table 1) involved more than one partner university, demonstrating our commitment to collaboration. Six projects are complete, four projects have final reports pending, and one is still active.

Competitive, peer-review project selection process.

General Research: In August 2021, eight projects were selected for funding through a competitive RFP similar to previous funding cycles. Projects were externally peer-reviewed, ranked and selected by the Executive Committee (Appendix, Table 6). The awards range from $44,963 to $75,000 for a total of $530,419 in NITC funding. One project is completed.

In July 2020, 11 projects were funded (Appendix, Table 5). The awards ranged from $67,619 to $147,448 for a total of $1,142,665 in grant funding. Their research progress was significantly affected by the COVID-19 pandemic. Seven projects are completed and four are still active.

In June 2019, 11 projects were funded (Appendix, Table 4). The awards ranged from $53,702 to $145,650 for a total of $1,035,794 in grant funding. These projects were significantly affected by the COVID-19 pandemic. Nine projects are completed and one is active.

The eleven projects funded through the second General Research RFP (Appendix, Table 3) are completed but awaiting the submission of one final report. These projects ranged from $38,049 to $149,973 for a total of $925,578.

For the first RFP, the six projects, ranging from $39,932 to $99,764, for a total of $437,762 (Appendix, Table 2) are completed.

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. Four projects are complete. One is expected to be completed by the end of the year. 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, with one final report pending.

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.

Research Roadmaps

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

The Research Roadmaps aim to assess the cumulative body of UTC-funded research and help define what future research and workforce development efforts UTCs can embark on to meet the most important challenges facing transportation agencies and policymakers. Each Research Roadmap included the following: overview, current knowledge, research gaps, and workforce needs. During the process of developing the Roadmap, each team held at least one virtual workshop with practitioners to help assess key gaps and workforce needs. The six roadmaps were funded at $50,000 each for a total of $300,000. These are complete and available on-line.

1.2.2 Leadership

High Standing within National and International Arenas of Transportation

- NITC Director, Jennifer Dill PSU, is serving on the Peer Review Expert Panel for FHWA's Mobility Trends and Future Demand study. She was also selected by TRB to chair the 7th International Conference on Women's Issues in Transportation, to be held September 2024.
- A special edition of the Journal of Comparative Urban Law and Policy celebrated Arthur Chris Nelson, UA, and his 50 years of contributions to planning research & practice - https://readingroom.law.gsu.edu/jculp/vol5/iss1
- Anne Brown and Amanda Howell's NITC-funded research on micromobility and equity was highlighted on Smart Cities Dive.
- Professor Miguel Figliozzi presented "Working towards More Equitable Goods Movements" as a keynote speaker at the 7th Annual UTC Conference for the Southeastern Region in Boca Raton, Florida, and presented at the University of California Davis Transportation Seminar on the topic "E-commerce, Equity, and Accessibility".
- Sirisha Kothuri, PSU, presented as a part of a panel on Counting Small Things on Wheels discussing best practices for creating truly inclusive, transparent bike count programs on September 7, at the NACTO Designing Cities Conference. She also presented key findings from research into pedestrian satisfaction in a TRB Webinar: Pedestrian Analysis—Current Practice, Resources, and Applications on September 27, 2022. This webinar was based on NCHRP Report 992: Guide to Pedestrian Analysis.

- John MacArthur delivered a presentation on e-bike incentive programs at Forward Pinellas' quarterly committee meeting on micromobility, composed of city, county, and state planners. Forward Pinellas serves as the planning council and metropolitan planning organization for Pinellas County, Florida. The Pinellas County planner stated, "I am a planner working on e-bike regulations and we have been following the research at TREC closely. Your work has been central to informing the public about e-bikes and e-scooter programs, safety and regulations."
- John MacArthur's work on e-bike incentive programs continues to gain traction as he presented at a recent Ride Report Webinar on The Rise Of Ebike Voucher Programs alongside industry partners including PeopleForBikes, the Colorado Energy Office and the city and county of Denver. The Connecticut Electric Bicycle (E-Bike) Incentive Program directly references the work in their Request for Information (RFI) to obtain data and feedback necessary to design and implement an E-bike incentive program.

Solving Regional and National Transportation Problems

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

- Building on NITC-funded research, Xiaoyue Cathy Liu and Nikola Markovic (UU) will assist the Utah Transit Authority (UTA) in designing a dynamic service with zero-emission transit vehicles to enhance service equity and efficiency for a vulnerable population. Dr. Liu's earlier NITC work has helped transit agencies transition their fleets to battery electric buses, improving air quality with an eye toward environmental justice.
- Nicole Iroz-Elardo of UA presented "At the Intersection of Safety and Mobility: Adaptations for Great Places and Streets" about a NITC-funded cool pavement study to reduce the urban heat island effect, at the second annual "Moving Tucson" summit, an event organized by the City of Tucson Department of Transportation and Mobility. Also presenting on the same panel was Tara Goddard of Texas A&M University, who is a former PSU graduate & past NITC dissertation fellow.
- The keynote speaker at the Arizona summit mentioned above was also a NITC researcher: Ivis Garcia of the University of Utah, who spoke about housing and transportation equity.
- Jennifer Dill, PSU, participated in a Congressional briefing webinar, Charging Ahead on Micromobility Policy, along with Congressman Earl Blumenauer, Lyft and the New Urban Mobility Alliance.
- Basem Elazzabi (PSU) gave a presentation to the Washington DOT and other Washington MPOs about PORTAL. The presentation focused on data monitoring, evaluation and adjustment (of performance targets and programming selection). This presentation was organized through the FHWA Resource Center.
- Jenny Liu, PSU, and Master's student Rohan Khanvikar talked about their transportation finance research on the KOIN news, CBS News Portland Affiliate on September 30, 2022.
- Hau Hagedorn and Tammy Lee, PSU, led a workshop on Understanding How Bicycle and Pedestrian Count Data Affects Your Program's Decision Making Process at the Association for Pedestrian and Bicycle Professionals (APBP) Conference on August 25, 2022.

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 79 research projects, only two do not directly support students, and 58% support untenured, tenure-track faculty.

- UA civil and architectural engineering and mechanics assistant professor Alyssa Ryan has won a 2022 Young Leaders to Follow Award from the Institute of Transportation Engineers (ITE). "This award is very meaningful for me, as ITE is an organization I greatly respect," Ryan said. "I have seen how they are capable of leading conversations in the transportation industry and engineering space about topics including diversity, equity and inclusion."
- Recent graduate, Gabby Abou-Zeid, now with ICF, presented alongside Allen Greenberg, FHWA on Impacts of City-Level Parking Cash-Out and Commuter Benefits Ordinances at a PSU Transportation Seminar on September 16, 2022.
- Ana Maki, UU, second year master's student worked on creating a new Transportation Equity program called "U in Motion" as an intern for UU's Sustainability Office.

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
Final reports	3,956
Project briefs	4,196
Webinars (views)	1,111
Datasets	73
Total	**9,380**

Downloads of final reports from project websites require downloaders to provide their email address, which NITC uses to request feedback. During this period, 120 people completed surveys on NITC reports: 49 practitioners, 25 faculty/researchers, 15 students, and 31 other stakeholders. Thirty-three 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%. Ninety-four percent of them rated the reports as very or somewhat useful, with 77% saying the reports met their needs, and 91% 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.

- NITC supports student groups on each of our partner campuses. The student groups have been active this past academic year. During this reporting period, a total of 24 meetings/events were attended by 324 participants (Appendix, Table 8).

- A group of UO students successfully engaged in an effort to map and document a significant number of bike parking racks throughout the City of Eugene (over 2,000). They worked with faculty researchers (Professors Anne Brown and Marc Schlossberg) and various community partners on the project, including the City of Eugene, Lane Council of Governments, Cascadia Mobility, and University of Oregon Transportation Services. The bike rack documentation data will directly serve the City of Eugene as it seeks to improve bicycle storage coverage and quality as bikeshare expands and scooter-share enters the city for the first time.
- PSU undergrad students worked with the city of Hood River on a quick build demonstration project that included a 2-way protected sidepath, crossbikes/walks and intersection mural which will be funded through an Oregon DOT grant. Students also worked with the city of Independence on a Neighborhood Greenways project connecting Independence Elementary School to three city parks and downtown Independence with pedestrian and bicycle friendly streets that promote safe, active transportation. A third group of students developed a detailed plan set and facility design that implements two protected bike lanes and two sidewalk corridors with landscaped buffer zones to Historic Parkrose Neighborhood Prosperity Initiative and stakeholders.

Develop Innovative New Curriculum and Learning Opportunities.

- Anne Brown, UO, has integrated equity into a travel behavior curriculum. It includes five distinct curriculum resources to engage students in key equity considerations and questions that shared mobility presents to transportation professionals: 1) suggested reading list; 2) lecture slides + recorded video lecture; 3) in-class student activity; 4) discussion questions; and 5) teaching guides.
- Bruce Irvin (PSU computer science teaching faculty) taught a data engineering course spring quarter using transit data.

Educate Professionals

During the reporting period, NITC supported 23 events that were attended by 963 people: four NITC webinars (410 attendees) and seven Friday Transportation Seminars (553 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 1,248 AICP credits, and the practitioners rated TREC's events 3.92 out of 5 stars. Since 2000, the events have a 4.0 out of 5 rating from 13,806 reviews.

PSU's bikeway design workshop continues to attract professionals across North America. This immersive, hands-on, weeklong workshop combines classroom training with daily field tours so that transportation professionals can experience the implementation of some of the designs they've only seen in guidebooks or presentations. The workshop hosted in August on the PSU campus included 18 participants.

Attract and Support Undergraduate Students.

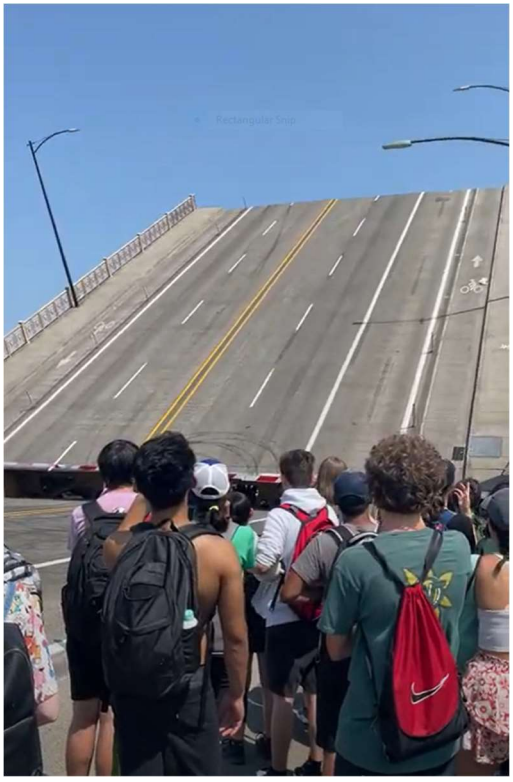
NITC recognizes that transportation workforce development does not always take place at the university level. Students' interest in transportation can start much earlier, which is why NITC aims to attract and retain new undergraduate students to transportation-related degree programs and increase the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

- To introduce high school students to geographic information systems (GIS) and spatial reasoning skills, researchers at the University of Texas at Arlington (UTA) developed a four-week training workshop in ArcGIS and other emerging regional mapping technologies. The workshop was incorporated into an existing high school course focused on the transportation network and environmental justice issues."

- 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.

- UO's informal transportation chit chat series called "Bean Bag Conversations we're Having About Transportation (BBCHAT)" has successfully taken place several times this past year with a fusion of undergraduate and graduate students from different disciplines, alongside a few local transportation professionals or advocates; these are open-ended, though thematic, conversations designed to be a welcoming environment for students who are loving or exploring transportation issues.

- PSU hosted nineteen students as part of the National Summer Transportation Institute, a week-long residential camp for high schoolers. Students met professionals, practiced data collection and urban design, and went on daily field trips to places that aren't normally open to the public - clambering through the interior of Multnomah County's bridges, or getting behind the wheel of TriMet's indoor bus driving simulator. The objectives of the camp were to: (1) improve STEM skills, (2) provide awareness about transportation related careers, (3) encourage students to consider transportation related fields of study in their higher education pursuits, and (4) attract underserved, underrepresented students to the transportation field. The photo on the right shows the students on a walking tour of Portland's bridges and watching a bascule bridge lift in action.



Attract and Support Graduate Students.

Students in Transportation Engineering and Planning (ITE-STEP) at PSU won the 2022 National Student Chapter Momentum Award. The award recognizes the student group for an outstanding year of accomplishments. ITE-STEP comprises mostly graduate students but also includes undergraduate students.

The Transportation Undergraduate Research Fellowship (TURF) program at Portland State University has hosted twenty-four fellows since 2017, and prioritizes underrepresented students. This summer, six undergraduate researchers worked on projects aimed at improving the safety and efficiency of multimodal transportation systems. The work of three former TURF students contributed to publishing an article in the August 2022 issue of the Journal of Transport and Land Use. The article, "Congested sidewalks: The effects of the built environment on e-scooter parking compliance," was co-authored by Rob Hemphill (alumni), John MacArthur, Jennifer Dill and Philip Longenecker (alumni) of Portland State

University; Garima Desai, University of California, Santa Cruz; Lillie Nie, University of Southern California; and Abbey Ibarra, California State Polytechnic University-Pomona.

1.2.4 Technology Transfer

Move Research into Practice.

NITC's Translate Research to Practice initiative allows researchers to build on previous NITC projects' accomplishments, strengthen partnerships with transportation agencies and community organizations, and produce outputs for practitioners. NITC awarded five projects for a total of $297,223 (Appendix, Table 7). Two of the projects are complete and actively implemented across the country.

The Transportation Academy handbook developed by Keith Bartholomew (UU) and Nathan McNeil proved useful to Wisconsin. A staff person from 1000 Friends of Wisconsin stated, "We are a statewide nonprofit dedicated to good land use and transportation planning in Wisconsin and are developing a community transportation academy here, piloting the program in La Crosse. The handbook has been extremely useful, and Nathan McNeil and Keith Bartholomew have both been very helpful and responsive when I email them with questions."

Based on the survey responses collected, practitioners that attended the Webinar: Mobility for the People shared ways in which they will use what they learned including:

- Considering applications in transportation demand management and transportation systems management and operations, intelligent transportation systems, and to encourage the use of the results.
- Many referenced the usefulness of the dashboard in helping to see what other cities are doing.
- Another participant stated, "I am helping to start a bikeshare program in Sonoma County, CA. I plan to use the tools that I learned about during this webinar."
- This research is helpful for the League of American Bicyclists' Bicycle Friendly Community program, which recently underwent a major equity-related update, to help inform how we should evaluate communities' shared micro-mobility programs from an equity lens.

Kristi Currans and Ladd Keith presented their research on Planning for Urban Heat Resilience at the Cool Roof Outreach Quarterly Meeting, hosted by Global Cool Cities Alliance (GCCA) on June 20. They also presented their work on Cool Corridors as part of the 2022 Climate 101 Workshop, hosted by South Central Climate Adaptation Science Center (SCCASC) on August 19, 2022.

Use Innovative Approaches to Communicate Research Results.

Visitors and engagement has grown across all social media platforms, the NITC website, and our newsletters. Updated daily, the NITC website saw 15,506 site visitors during this reporting period. Our highest engagement with U.S. web visitors by state is as follows: California, Oregon, Virginia, Texas, Washington, and New York.

We published twenty-six NITC stories on research results, newly funded projects, the impact of events, and monthly NITC Student Spotlight interviews. The Spotlights showcase the outstanding students supported by NITC funding, including student group leaders, NITC Dissertation Fellows, and research assistants on NITC-funded projects. All of these stories are shared in our monthly NITC newsletter with 5,938 subscribers (20% open rate; 19.9% click-through rate) dedicated to communicating NITC research and events.

Nathan McNeil, Portland State University, participated in the Podcast: The Academic Minute where he talked about Piloting a Transportation Incentive Program to Support Residents of Affordable Housing (a NITC-funded project). He and Keith Bartholomew (UU) participated in the Streetsblog podcast THE BRAKE: Should Cities Train Their Own Transportation Advocates? on April 26, 2022 for another NITC-related project.

1.2.5 Collaboration

Collaborating within our consortium.

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

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

Kristi Currans, UA, was a guest lecturer for PSU's Transportation and Health course. The topic was "Assessing Cool Corridor Heat Resilience Strategies for Human-Scale Transportation".

External collaboration

External collaboration is a significant part of NITC's applied research and technology transfer projects. These collaborations allow the research results to be implemented. For example, external collaboration has been critical to the success of OIT's project "Use of Mt. Mazama Volcanic Ash as Natural Pozzolans for Sustainable Soil and Unpaved Road Improvement," which involves a number of partners including the Wingwatchers Board, Oregon Department of Transportation, City of Klamath Falls Engineering and Parks Departments, and Klamath Trails Alliance. These partners play a role in potentially using Mt. Mazama Ash as a viable alternative to trail pavements.

For the project "Using Maps and Online Tools to Operationalize Equity in Shared Mobility Services", researchers Amanda Howell and Anne Brown, UO, worked closely with community partners such as Asian Pacific Network of Oregon and RAHOK to ensure that their understanding and integration of equity in their tools reflected and supported the existing work these community-based organizations. They also work with NGOs, The Greenlining Institute and PeopleforBikes, to disseminate the results to more stakeholders.

1.2.6 Diversity

Attract underrepresented students to transportation careers

NITC uses several approaches aimed at attracting women and people of color into the transportation field. This includes offering programs and fostering partnerships that achieve this goal. For example, grants to include underrepresented students in research have significant impact on positionality, how differences in social position and power shape identities and access in society. Over half of our research projects have a significant focus on equity. In the Appendix, Tables 1-6, these 39 projects are indicated by asterisks after their titles. Programs such as the summer transportation institute and the transportation undergraduate research fellowship mentioned above prioritize and attract students from underrepresented groups.

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

2 PARTICIPANTS & COLLABORATING ORGANIZATIONS: Who has been involved?

2.1 What organizations have been involved as partners?

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

2.2 Have other collaborators or contacts been involved?

Cathay Liu, UU, and her research team presented their work on a Battery Electric Bus visualization tool to Sun Tran (Arizona) as an additional transit agency to demonstrate tech transfer. Sun Tran is in the process of retrieving needed data and the research team will implement their network using our optimization pipeline to demonstrate the BEB deployment effectiveness. Salt Lake County is also interested in their modeling result and to further guide the BEB investment.

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

Technology transfer performance measures are summarized in Table 11.

3.1 Publications, conference papers, presentations, and events

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

Researchers Aaron Golub, John MacArthur and Sangwan Lee of Portland State University, Anne Brown of the University of Oregon, and Candace Brakewood and Abubakr Ziedan of the University of Tennessee, Knoxville have published a new journal article in the September 2022 volume of

Transportation Research: Interdisciplinary Perspectives. The article, "Equity and exclusion issues in cashless fare payment systems for public transportation," explores the challenges facing transit riders in the U.S. who lack access to bank accounts or smartphones, and potential solutions to ensure that a transition to cashless transit fares does not exclude riders. This article is based on the NITC Pooled Fund project.

3.2 Websites or other Internet sites

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

- NITC website: Updated daily, the website provides comprehensive information about our center and complete research portfolio. This includes stories about our research, press coverage, tech transfer resources, professional development events, and opportunities for students.
- Twitter (TREC: 4,092 followers, +110): 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 663 followers, +68) offers more effective framing of the consortium partnership.
- Facebook (1,090 followers, +18): In addition to sharing research, this platform shares photos of our events and offers connections with other organizations, researchers, and practitioners.
- YouTube (1,180 subscribers, +100): Where we publish freely accessible video recordings of weekly seminars at PSU, monthly NITC webinars, special lectures, student spotlights and more.
- LinkedIn (1,067 followers, +225): 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 (734 followers, +49): 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 963 people: 4 NITC webinars (410 attendees) and 7 Friday Transportation Seminars (553 attendees). These events are eligible for AICP professional development credit.

3.4 Technologies or techniques

One of the outputs of the Enabling Decision-Making in Battery Electric Bus (BEB) Deployment through Interactive Visualization project is a prototype of the BEB visualization tool. Very few agencies have a systemic approach for BEB deployment at the current stage. And as vehicle electrification is getting more and more popular, the research results offer a valuable resource for transit agencies and practitioners to implement the BEB for their own network.

Researchers Anne Brown and Amanda Howell developed two tools based on NITC-funded research: the US Micromobility Equity Requirements Dashboard and Shared Micromobility Equity Evaluation Tool. These tools aim to change practice by giving planners and policymakers the information they need to

craft micromobility policies that are centered on equitable mobility outcomes. The mapping tool will provide them with easily accessible information about what other cities around the U.S. are doing, with links to RFPs, operating agreements, permit language, and other information that they can use for reference. From their research, they have found that many shared micromobility programs are focused on equitable access rather than outcomes, in part because there's a lack of alignment between goals, implementation, and evaluation. The equity evaluation tool will hopefully change practice by encouraging planners and policymakers to ensure program alignment with clearly defined equity goals, and by helping them identify where there is room for improvement.

3.5 Inventions, patent applications, and/or licenses

Taylor Li, UTA, has submitted a patent application on technology developed for NITC-funded project, Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors. The patent is for technology using Lidar, machine learning algorithms, and software to detect pedestrians and control permissive left turn signals to improve pedestrian safety.

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: Wingwatchers Board, Oregon Department of Transportation, City of Klamath Falls Engineering and Parks Departments, Klamath Trails Alliance, Sun Tran, Salt Lake County, Greenlining, Asian Pacific Network of Oregon, RAHOK, and People for Bikes

2. Number of projects that reach deployment and adoption (measured by the number of projects that reach TRL scale 4 or 5): 14

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. Fifty-seven 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?

Researchers Anne Brown and Amanda Howell have collected documentation about equity requirements from 239 shared micromobility programs across the U.S. and compiled all the data into an online dashboard, which city officials can use to find what other similar-sized cities are doing.

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

- "E-bikes and e-cargo bikes give people freedom of mobility while reducing their carbon footprint," said Jack Todd, the communications director of Bicycle Colorado. "Research from the National Institute for Transportation and Communities shows that people are purchasing e-bikes to replace car trips and travel with heavier loads, greater distances, at an older age or with mobility issues, and to commute to places without worrying about appearing disheveled at their destination. They are a game-changer when it comes to getting people to leave the car at home and choose two wheels instead of four."
- The city of Olympia, WA is doing some TOD planning work. NITC's research on "Is Transit-Oriented Development Affordable for Low and Moderate Income Households?" was really helpful to understand potential impacts on low- or moderate-income households.
- The research results from the study "New Mobility For All: Can Targeted Information And Incentives Help Underserved Communities Realize The Potential Of Emerging Mobility Options?" is being used to inform similar mobility. From the report downloads, a practitioner in Los Angeles stated, "We are launching a similar project in Los Angeles so I commonly refer to this report to see what instruments were used and what results we might expect. There's some nitty gritty stuff that I am also interested in (mostly with regards to data sharing) but for those things I just contact the author directly."
- NITC-funded work on "How Can E-bike Purchase Incentives Grow the E-bike Market?" continues to inform the design of programs across the country. The latest is from the San Francisco County Transportation Authority. They state, "We are considering implementing an e-bike incentive program, so this research has been super helpful for understanding the state of the art. Especially love the flowchart for designing a program!"
- Similarly, results from "Scooting to a New Era in Active Transportation: Examining the Use and Safety of E-Scooters" is helping to shape legislation in Pennsylvania. "[The] Report [was] used to brief state DOT staff as we reviewed potential legislation to permit pilot e-scooter programs in Pennsylvania."

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?

N/A

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.

PSU's research on the role of e-bikes in fighting climate change was cited by Rolling Stone revealing the potential to reduce carbon emissions from passenger transportation by 12 percent.

Ladd Keith and Kristi Currans, UA, research on cool pavements is actively contributing to scientific knowledge. Other cities across the United States have launched or are exploring similar pilot programs that add cool pavement coating to their streets. This research confirms similar studies that use on-the-ground measurements to explore the effectiveness of cool pavements.

5.4 What is the impact on transportation workforce development?

The skills and knowledge of the current transportation workforce needs to keep pace with the changing technology, policy, and best practices. NITC has made significant impacts training the current transportation workforce in several areas. Webinars and seminars are important to building the skills and knowledge for the current workforce. Since the last reporting period, we received feedback from 362 webinar / seminar participants where 93% noted that the purpose for attending was professional development; with 91% indicated that the training met their purposes. For example, feedback from the webinar "Scooting to Healthy and Safe Mode Choices" included:

- The information is great for building my knowledge base concerning micro mobility. The knowledge is helpful going forward in conversations about whether my municipality will allow e-scooters to operate, and also in potential conversations about establishing a bike share.
- We have an upcoming municipal traffic engineering project that this information will be of use on.
- The information provided informs my work on mobility infrastructure and expanding access to shared micromobility.

As a part of PSU's bikeway design workshop, participants share their experiences at the end of week. Some of the reflections include:

- One participant described the class as an "incredible opportunity". She said it's one thing to hear about designs and approaches from an academic perspective, but quite another to experience it on the ground. She appreciated the power of signal timing to achieve good results. She also appreciated that design is not just about safety, but about making biking preferable to driving. She took away the importance of being able to ride side-by-side.
- Another participant mentioned that prior to this class his impressions of bicycle boulevards were not great. He considered them just shared roadways with sharrows. Touring NW Flanders and other boulevards was "really nice". Furthermore, at his MPO he feels that they are disconnected from policy and he'd like to try to better connect that with design.

Inspiring alumni shaping transportation

- PSU Alum Darwin Moosavi was in the 2022 40 Under 40 for Mass Transit Magazine.
- PSU Alum, Ray Delahanty, has one of the most popular transportation-focused YouTube channels, CityNerd. He currently has over 94,000 subscribers and a following among aspiring transportation

professionals. We are seeing high school students that participate in our summer transportation camp becoming interested in transportation via social media especially YouTube channels similar to CityNerd.

- UO alum, Dave Amos, runs an extremely popular YouTube channel on city planning, often with a frequent connection to transportation issues. His City Beautiful channel has over 120 videos with his highest viewed video, 'The Reason Our Streets Switched to Cul-De-Sacs,' watched over 4 million times. As a UO student and then as an expert advisor, Dave has been co-author of all three of NITC's Rethinking Streets book series. After graduation and working as a professional city planner, he decided to earn his PhD from Berkeley and is now an Assistant Professor at Cal Poly SLO.
- UU Alum Clint Harper now works as the City of Los Angeles' Advanced Air Mobility Fellow, facilitating relationships to integrate emerging Advanced Air Mobility technology as a complement to local and regional transportation systems, particularly active transportation and transit networks.
- UU Alum Megan Townsend was recently awarded the College of Architecture + Planning's Young Alumna award. She oversees planning technical assistance and economic development activity as the Director of Community and Economic Development of the Wasatch Front Regional Council, a Metropolitan Planning Organization.
- UU Alum and past NITC dissertation fellow Torrey Lyons is currently serving the Joint Office of Energy and Transportation in its efforts to support states in the planning of an equitable national charging network. Lyons is a policy analyst at Idaho National Laboratory.

Next generation of faculty

PSU hosted another workshop for faculty to learn about integrating bicycle and pedestrian topics into their university curriculum. Eight faculty members attended from across the country, with one from Japan. There are two examples of direct outcomes. A faculty member from Montana State University will use the information from the course to help develop a Transportation & Health course for the Spring of 2023 at MSU so all of these resources will be extremely handy. Another faculty is modifying their syllabus that will integrate into a module for their existing class with the hope of having a standalone class by 2023. We continue to see evidence of faculty downloading and using our curriculum materials such as the Pedestrian Observation and Data Collection Curriculum Guide funded from a previous UTC-grant. The resources are being integrated into an Introduction to Civil Engineering course at Southern Methodist University; and used by a faculty member at Southern Utah University.

6 CHANGES/PROBLEMS

6.1 Changes in approach and reasons for change

In-person activities have continued in Fall 2022. In spite of this, we continue to offer online or hybrid options for many courses, events, and other activities in order to make learning opportunities available to people with health concerns related to COVID-19 and other challenges.

6.2 Changes that have a significant impact on expenditures

There are no significant impacts on expenditures.

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

No significant changes.

6.4 Change of primary performance site location from that originally proposed

No updates.

7 SPECIAL REPORTING REQUIREMENTS

No requirements.

4 APPENDIX

Table 1: Initial research projects 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	Complete (final report pending)
	From Knowledge to Practice: Rethinking Streets for People on Bikes	Marc Schlossberg Roger Lindgren	UO OIT	Complete
	Improving Integration of Transit Operations and Bicycle Infrastructure at the Stop Level	Miguel Figliozzi Chris Monsere	PSU	Complete
	Key Enhancements to Four-Step Travel Demand Models	Reid Ewing	UU	Complete
	Network Effects of Disruptive Traffic Events	Juan Medina Cathy Liu	UU	Complete (final report pending)
	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	Complete (final report pending)

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

Grant	Project Title	Investigators	Univ.	Status
(Round 1)	Understanding Factors Affecting Arterial Reliability Performance Metrics	Avinash Unnikrishnan Sirisha Kothuri	PSU	Complete
	Planning in Gateway and Amenity Communities: Understanding Unique Challenges Associated with Transportation, Mobility, and Access to Opportunity*	Danya Rumore Philip Stoker	UU UA	Complete
	Developing Data, Models, and Tools to Enhance Transportation Equity*	Amy Lubitow Julius McGee Raoul Lievanos	PSU UO	Complete
	Universally Accessible Trail Improvement with Naturally Occurring, Sustainable Materials*	Matthew Sleep	OIT	Complete
Small Starts (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

Grant	Project Title	Investigators	Univ.	Status
	Matching the Speed of Technology with the Speed of Local Government: Developing Flexible Codes and Policies Related to the Possible Impacts of Autonomous Vehicles on Cities	Marc Schlossberg Heather Brinton	UO	Complete
	Reducing VMT, Encouraging Walk Trips, and Facilitating Efficient Trip Chains through Polycentric Development	Reid Ewing Yehua Dennis Wei Shima Hamidi	UU UTA	Complete
	An Electric Bus Deployment Framework for Improved Air Quality and Transit Operational Efficiency *	Xiaoyue Liu Aaron Golub Ran Wei	UU PSU UCR	Complete
	Connected Vehicle System Design for Signalized Arterials	Xianfeng Yang Mingyue Ji	UU	Complete
	Revisiting TODs: How Subsequent Development Affects the Travel Behavior of Residents in Existing Transit-Oriented Developments	Nathan McNeil Jennifer Dill	PSU	Complete
	Optimizing Housing and Service Locations to Provide Mobility to Meet the Mandated Obligations for Former Offenders to Improve Community Health and Safety*	Anne Nordberg Jaya Davis Stephen Mattingly	UTA	Complete
	Land Use and Transportation Policies for a Sustainable Future with Autonomous Vehicles: Scenario Analysis with Simulations	Liming Wang Yao-Jan Wu	PSU UA	Active
	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	PSU	Complete

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

*Research projects that address equity related to mobility

Table 4: 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	Complete
	New Mobility For All: Can Targeted Information And Incentives Help Underserved Communities Realize The Potential Of Emerging Mobility Options?*	Nathan McNeil John MacArthur Jennifer Dill	PSU	Complete
	Developing Strategies To Enhance Mobility And Accessibility For Community-Dwelling Older Adults*	Kate Hyun Caroline Krejci Kathy Lee	UTA	Complete
	Using Social Network Analysis To Optimize Access To Culturally Responsive And Affordable Transportation For Older (Im)Migrants*	Rebecca Mauldin Stephen Mattingly Rupal Parekh	UTA UTA UConn	Active
	Green Waves, Machine Learning, and Predictive Analytics: Making Streets Better for People on Bike & Scooter	Stephen Fickas	UO	Complete
	Rethinking Streets for COVID-19	Marc Schlossberg	UO	Complete
	Data-Driven Mobility Strategies for Multi-Modal Transportation	Yao-Jan Wu Sirisha Kothuri Xianfeng Yang	UA PSU UU	Complete
	Development Of Low-Cost Radar-Based Sensor For Multi-Modal Traffic Monitoring	Siyang Cao Yao-Jan Wu	UA	Complete

Grant	Project Title	Investigators	Univ.	Status
	Evaluation of Portland Shared E-Scooter Pilot Program Goals and Outcomes *	John MacArthur Jennifer Dill	PSU	Complete
	Scooting to a New Era in Active Transportation: Examining the Use and Safety of E-Scooters *	Kristina Currans Reid Ewing Nicole Iroz-Elardo	UA UU UA	Complete
Small Starts (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
	E-Scooters and Public Health: Understanding the Implications of E-Scooters on Chronic Disease *	Nicole Iroz-Elardo	UA	Complete (final report pending)
	The Impact of Ride Hail Services on the Accessibility of Nonprofit Services *	Dyana Mason	UO	Complete

*Research projects that include an equity focus related to mobility

Table 5: 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	Complete
	Understanding the Mobility Impacts of Decentralizing Homeless Services in Salt Lake County, Utah *	Sarah Canham Ivis Garcia	UU	Complete
	Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors *	Taylor Li Sirisha Kothuri	UTA PSU	Complete (final report pending)
	App-based Data Collection to Characterize Latent Transportation Demand within Marginalized and Underserved Populations *	Noelle Fields Courtney Cronley	UTA UTK	Active
	Mobility for the People: Evaluating Equity Requirements in Shared Mobility Programs *	Anne Brown Amanda Howell	UO	Complete

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

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
	Towards Data and Solution-Focused Approaches to Support Homeless Populations on Public Transit *	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	Complete

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	Complete
	Implementing a Community Transportation Academy	Nathan McNeil Keith Bartholomew	PSU UU	Complete
	Enabling Decision-Making in Battery Electric Bus Deployment through Interactive Visualization	Xiaoyue Cathy Liu Jianli Chen	UU	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)	Oregon Active Transportation Summit	4/25-4/27/2022	4
	Fehr and Peers guest speakers	5/10/2022	8
	ITE Quad Conference	5/29-6/1/2022	2
	Year in Review STEP Gathering	6/3/2022	12
	ITE Western District Annual Meeting	6/26-6/29/2022	2
ITE (OIT)	WTS Annual Conference, Seattle	4/18-20/22	1
	ITE Student Tour of Klamath Falls Regional Airport	4/19/22	12
	ITE Western District Meeting, Palm Springs, CA	7/5/22	2
Live Move (UO)	BB Chat	4/1/22	8
	Community Planning & Development Panel	May 22	20
ITE (UTA)	Economic Development Finance Professional (EDFP)	04/08/19	35
	American Planning Association 2019 National Planning Conference	04/13/19	60
	Association for Commuter Transportation 2019 Emerging Mobility Summit	04/18/19	60
	TexITE meeting	04/20/19	6
Point B (UU)	Utah Bike Summit	04/19/2022	5
	Campus Bike Census	04/20/2022	14
	SLC Bike Tour	04/23/2022	10
	Park City Transit mapping	June 2022	6
	Point B Brainstorm	06/02/2022	9
	Association of Pedestrian and Bicycle Professionals meeting	09/20/2022	21
	Point B Lecture Series: Lynn Jacobs	9/28/2022	27
UA	ITE and ASCE Joint Meeting	08/31/22	40
	ITE General Body Meeting - Analysis of Driver Behavior to Improve Safety, by Alyssa Ryan	09/14/22	15
	ITE General Body Meeting - Transportation Planning and Traffic operations by Kimley-Horn Employee	09/28/22	15

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	19
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	15
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	25
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.	3
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	17
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	35
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	2
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	9

Publication citations (alphabetical by author) and DOIs	# of Citations
Iuliano, J. E. (2022). Where and how tucsonans ride and implications for cycling infrastructure. Cogent Social Sciences, 8(1).	0
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	3
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	4
Kim, J. Y., Bartholomew, K., & Ewing, R. (2020). Another one rides the bus? The connections between bus stop amenities, bus ridership, and ADA paratransit demand. Transportation Research Part a-Policy and Practice, 135, 280-288. doi:10.1016/j.tra.2020.03.019	14
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
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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
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Table 10: Organizations partnering with NITC projects.

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

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
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]
OPAL Environmental Justice	Portland, OR				x[1]
PeopleforBikes	Boulder, CO	x			
Pima County DOT	Arizona	x			
Portland Metro	Portland, OR	x	x		x[1,4]
Project 7B	Utah	x	x	x	
Puget Sound Regional Council	Washington				x[1]
RAHOK	Pasadena, CA		x		
Regional Disaster Preparedness Organization	Portland, OR			x	
Regional Transportation Commission of Southern NV	Nevada	x			
Regional Transportation Council	Dallas-Fort Worth, TX				x[1]
Regional Transportation District	Denver, CO	x			x[1]
Resource Systems Group (RSG)	Salt Lake City, UT			x	
Rowell Brokaw Architects	Eugene, OR	x	x		x[2]
Salt Lake City Corporation	Salt Lake City, UT	x	x		
Salt Lake County Planning & Transp.	Salt Lake City, UT	x			
Sixty and Better	Fort Worth, TX		x		
Smart Growth America	Washington, DC				x[1]
South Tabor Neighborhood Association	Portland, OR		x		x1

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
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		
Utah Commission on Aging	Utah				x[1]
USTAR - Utah Office of Economic Development	Salt Lake City, UT	x			
Utah Division of Emergency Management	Utah		x		
Utah Inland Port Authority	Utah		x		
Utah Office of Tourism	Utah	x	x	x	
Utah DOT	Salt Lake City, UT	x		x	x[1]
Utah Transit Authority	Salt Lake City, UT	x		x	
Virginia DOT	Richmond, VA	x			
Volunteers of America, Utah	Salt Lake City, Utah		x		
Wasatch Front Regional Council	Salt Lake City, UT	x		x	x[1]
Washington County Engineering & Construction Services	Hillsboro, OR			x	
Washington Department of Transportation	Olympia, WA				x[1]

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

Table 11. Technology Transfer Performance Metrics

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
Outputs	Number of final reports 38 total	Produce final report that clearly articulate research results and meet NITC standards (KPI: 1 final report/project) On track
	Number of publications in trade/professional publications 56	Meet or exceed the number of publications (KPI: 1 publication/project) On track
	Number of presentations at national/ international and professional/trade conferences 27 last six months	Meet or exceed the number of presentations (KPI: 1 presentation/project) On track
	Number of events and event participants for technology transfer 43 events average 73 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 10 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 25 in the last six months	Meet or exceed the number of media stories (KPI: 30/year) On track
	Percentage increase in online engagement with new stakeholders: NITC Newsletter (subscribers) - 0% NITC Twitter - 11% Facebook - 2% YouTube - 9% LinkedIn - 27% Instagram - 7% Ongoing performance of online engagement NITC Newsletter (open rate) - 20% NITC Newsletter (click-through rate) - 19.9% NITC Website (# of site visitors) - 15,506	Meet or exceed our currently high averages for online engagement metrics (KPI: 10% or greater increase in new stakeholders across platforms -and- Meet or exceed baseline for ongoing online engagement NITC Newsletter (open rate) - 18.7% NITC Newsletter (click-through rate) - 19.5% NITC Website (# of site visitors) - 10,900 per 6 months On track
Outcomes	Number of stakeholders who collaborated on implementing research outcomes 10 stakeholders	Meet or exceed the number of stakeholders involved (KPI: TBD) In progress. Two is the baseline.

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
	Number of projects that reach deployment and adoption. 14 projects	Meet or exceed number of projects that reach TRL scale 4-5 (KPI: TBD) In progress. Six is the baseline.
Impacts	Number of stakeholders reporting impact from surveys Practitioners 49 Faculty/Researchers 25 Students 15 Other stakeholders 31	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