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 supported larger-scale projects. The Small Starts grant program funded researchers who had not yet had the opportunity to undertake significant transportation research. All projects were consistent with NITC's theme, externally peer-reviewed, and selected by the NITC Executive Committee via consensus. We selected projects through five competitive grants cycles. Of the 79 research projects funded, 10 projects are at the final report stage which includes report submission, final report peer-review and editing. There are 3 active projects. The focus for the remaining grant period is technology transfer and sharing research results. The projects and status can be found in the Appendix, Tables 1-6.

NITC's pooled fund projects and research roadmaps are all completed. The final reports are available online.

1.2.2 Leadership

High Standing within National and International Arenas of Transportation

- Nathan McNeil and Keith Bartholomew's paper "Transportation Academies as Catalysts for Civic Engagement in Transportation Decision-making," was selected as the winner of the Charley V. Wootan Award for the TRB Annual Conference. This award is given each year for the best paper in the area of transportation policy and organization.

Solving Regional and National Transportation Problems

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

- Hau Hagedorn moderated a panel on the Future of Transportation Funding at the Oregon Active Transportation Summit.

- 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.

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.

As a PhD student, Farzana worked on two NITC projects: "Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors" and "Using Social Network Analysis To Optimize Access To Culturally Responsive And Affordable Transportation For Older (Im)Migrants." After graduation, she began working as a young Associate Consultant for WSP. In the course of her work there, she has undertaken traffic simulation and impact analysis, trip generation matrix development, and the development of a Bus Rapid Transit (BRT) project for a major Texas city. The resources and technologies she used for NITC projects, including ArcGIS, PTV Vissim, and Synchro, she uses today to solve professional problems. "My overall journey so far has been significantly influenced by NITC. I received the training and confidence I needed at NITC to become a successful transportation engineer," Chowdhury said.

Justice P. Tuffour is a recent graduate of the Master of City and Metropolitan Planning program at the University of Utah. A dual recipient of the Department of Planning (CMP) and College of Architecture and Planning (CA+P) scholarships, Justice worked as a Graduate Teaching Assistant and a Research Assistant at the Metropolitan Research Center (MRC). Justice is currently working as a Planner and GIS Technician for the city of Holladay, UT. "I was particularly intrigued and attracted to the Department of City and Metropolitan Planning (CMP) program, at the University of Utah by the works of Professor Reid Ewing, whose enormous contributions to the field of urban planning and transportation systems remain ground-breaking," Tuffour said.

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. Downloads of final reports from project websites require downloaders to provide their email address, which NITC uses to request feedback. During this period, 114 people completed surveys on NITC reports: 52 practitioners, 21 faculty/researchers, 14 students, and 27 other stakeholders. Thirty-four of the respondents indicated that they downloaded the report to help make decisions about practice. Eighty five percent rated the reports as very or somewhat useful, with 92% rated the clarity of reports as excellent or good. We asked respondents the purpose for downloading the preort. The table below shows that 3% of respondents downloaded the report to help them make decisions about practice.

What was your purpose for downloading the report?	
Research proposal	4%
Thesis/ dissertation proposal	1%
Research project	18%
Inform public input process about a project	12%
I was involved in this project	6%
Help make decisions about practice	34%
Refer to a colleague	6%
Other	19%

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, 24 master's and 11 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.

PSU students in the Civil Engineering Capstone course worked with community partners on two significant projects. The BikeLoud/Living Streets capstone team assisted their client by investigating the objectives, engineering analysis, permits, and other considerations necessary for BikeLoud Day to take place. Their final design report, BikeLoud Day: Living Streets Downtown, includes an overview of the regulatory compliance and permitting requirements, an analysis of four possible locations for it to be held, and a Traffic Control Plan – a requirement for any temporary activity that will disrupt the normal flow of traffic. The proposed event plan and temporary design they came up with aims to promote a car-free lifestyle, increase cycling opportunities, and create a safe and accessible traffic space for the event. Another team worked on an intersection improvement project at NW Cornell Rd and Bethany Boulevard aims to make the intersection more accessible for pedestrians and bicyclists.

Students in the Master of Urban and Regional Planning Workshop course worked on several significant community-engaged projects including:

- Nixyáawii Watikš. The student team partnered with the planning office of the Confederated Tribes of the Umatilla Indian Reservation to plan a multi-use trail to improve walkability and connectivity in the community.
- Gorge & Mount Hood Regional Park & Ride. The purpose of this project is to develop a regional vision for park-and-ride facilities to increase and improve the park-and-ride system that serves the Columbia River Gorge and Mt. Hood region. The project focuses on the I-84, US 26, and OR 35 corridors, with a particular focus on underserved communities with limited access to the area.

- Tree Canopy Development in the 82nd Avenue Corridor. The recent jurisdictional transfer of 82nd Avenue from the Oregon Department of Transportation to the City of Portland presents a unique opportunity for initiating change. This team's' central focus is to provide support to the revitalization efforts on 82nd Avenue through a tree canopy development strategy. The major stakeholders include property owners, business owners, the City, and all users who live, work and play along 82nd Avenue.
- Fremont Bridgehead Reclamation. Over the last 50 years, major public projects have caused the decline of the thriving Eliot neighborhood in North and Northeast Portland, within the former city of Albina. This MURP team developed strategies advocating for the Oregon Department of Transportation (ODOT) and the City of Portland to redevelop 25 acres of land east of the Fremont Bridge. The project proposed shortening the offramp, creating a new roundabout, and reconnecting the grid of local streets. In consultation with community members, the team came up with options for land in the area owned by ODOT and the Portland Bureau of Transportation (PBOT) to be reconfigured to improve local access for residents.

Develop Innovative New Curriculum and Learning Opportunities.

Educate Professionals

During the reporting period, NITC supported 15 events that were attended by 1169 people: 4 NITC webinars with a total of 274 attendees, 8 transportation Seminars with 690 attendees and 3 other events with 205 attendees. The webinars and seminars are open to the public, webcasted to enable professionals and individuals across the country to participate, and recordings are posted on NITC/TREC websites. Each of these events offered one AICP professional development credit. During this period, practitioners participated in 107 unique training events. They rated the events 4 out of 5 stars. Since 2000, the events have a 4.0 out of 5 rating from 15,631 reviews.

Eighteen transportation professionals from across North America immersed themselves in a week-long Bikeway Design Course at PSU this summer (Figure 1). The importance of combining class room and field visits was reinforced by participants. One mentioned, "This course was a fantastic way to learn about the solutions in the classroom, then feel what they are like in the real world with on-bike site visits." Another offered, "it was very informative and the use of the tours to show real life examples helped extremely." The course is also integral for those without formal education or training on bikeway design. One student commented, "I was hoping to expand my knowledge of bikeway design and cycling infrastructure engineering from taking this course. That expectation was met. I now feel much more comfortable and confident explaining the more technical aspects of bikeway design and will use that knowledge (as a transportation planner) to work more productively with my engineering colleagues and more confidently with my clients."

Figure 1: Participants engaged in a classroom lecture with two city of Portland's bikeway design staff

Attract and Support Undergraduate Students.

NITC recognizes that the 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.

Nineteen high school students from across Oregon participated in the National Summer Transportation Institute (NSTI) at PSU. 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. As a high school junior, Isa Swain (current PSU civil engineering undergrad) attended the virtual version of the camp in 2020. This year, she was one of several counselors for the traditional residential program.

Figure 2: Students and camp counselors at the NSTI camp at PSU learned about traffic engineering from Phil Armand, guest speaker working with the Portland Bureau of Transportation.

Attract and Support Graduate Students.

NITC awarded scholarships to 94 Undergrad, Master's and Ph.D. students. NITC offers dissertation fellowships to Ph.D. students who have advanced to candidacy. This reporting period, Kelly Rodgers (PSU Dissertation Fellow) completed her dissertation on how health-related indicators are being used in municipal transportation plans, whether they are institutionalized into transportation agency decision-making processes, and what influence they have on administrative decision-making. Another NITC Dissertation Fellow, Austin Drukker, also completed his dissertation. His research sought to quantify the benefits of EAS to remote communities in order to understand whether EAS accomplished its goal of connecting these communities to the national air transportation network, or whether Congress should consider other policies to meet this objective.

1.2.4 Technology Transfer

Move Research into Practice.

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

Offering webinars is an effective method for moving research into practice. For example, numerous practitioners that participated in the Planning and Development in Gateway Communities, Post COVID webinar provided some feedback providing some good insight on aspects that were most useful:

- "I just finished viewing the presentation and I am about to ask my GIS analyst to follow the instructions provided to create a commuter-shed map. We are in the midst of updating our Comp Plan and that might be very helpful."
- "The Gateway and Natural Amenity Initiative (GNAI) is a great way to assess changes in growth pressures that small communities near major natural attractions are dealing with growth pressures, particularly since the pandemic."
- "Very nice overview of a very detailed study. Good info regarding resources that can be used in the future for gateway communities."
- "I thought the presentation was well organized and informative. It confirmed some of my suspicions when I've read about this topic in media stories (the New York Times ran a similar story on this issue during the pandemic), about subjects like housing costs and affordability, pressure on public services and amenities, etc. Where will the money come from for local communities like these gateway communities to help offset maintenance and repair costs? Always a hot topic of discussion. Good job."

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 8,605 site visitors during this reporting period. Our highest engagement with U.S. web visitors by state is as follows: Oregon ,California, Texas, Virginia, and Utah.

We published ten NITC stories on research results, newly funded projects, the impact of events, and 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 7,289 subscribers (23% open rate; 19.3% click-through rate) dedicated to communicating NITC research and events.

The graduate students that worked on the project, Understanding Connections Between Mobility, Transportation, And Quality Of Life In Refugee Communities In Tucson, Arizona, collaborated to create an illustrated student magazine titled "Making a Home: Transportation Mobility and Well-Being Among Tucson Refugees." The magazine is available on the project page along with other products of the research.

Kelly Clifton was interviewed on the Active Towns Channel about her work on Communicating Research through Comics: Transportation and Land Development. Comics are still seen as a novel and more approachable way to help better communicate transportation topics and research to the public.

1.2.5 Collaboration

NITC's governance structure is collaborative and encourages multiple perspectives on decision-making. 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.

External collaboration is a significant part of NITC's applied research and technology transfer projects in addition to course delivery. Some examples of this are below:

- With guidance from a Tenchical Advisory Committee of national transit experts and homeless service providers and a national synthesis survey of service providers, researchers (Anne Nordberg, Jaya Davis and Stephen Mattingly at University of Texas at Arlington) assessed the interface and gaps between the perspectives of the transit agencies, service providers and individuals experiencing homelessness. They came up with a set of recommendations to help Dallas Area Rapid Transit (DART) and homeless services providers meet the daily needs of individuals experiencing homelessness, including shifting from a "housing first" approach to focusing on housing and transportation together. The results of the study can inform DART's practices and those of other transit service providers as well as human services organizations.
- Researchers at the University of Texas, Arlington and the University of Connecticut teamed up to fill a gap in the knowledge of the elderly Vietnamese immigrant population in Dallas/Fort Worth. They sought to learn about the transportation behaviors not only of the Vietnamese adults but also of their ride providers.
- The study Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors demonstrates the multiple levels of collaboration among researchers and external stakeholders. The three researchers represent three of the NITC universities and the external collaborators include cities of Arlington and Irving, Texas, the Oregon Department of Transportation, and the Utah Transit Authority.

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.

The 2023 transportation summer camp was held last month, with activities including bike tours, a jet boat tour, an exploration of the inside of a couple of Portland's bridges, a bridge-building contest, and of course the presentation of students' final projects to friends and family. Guest instructors shared their expertise and career insights with students, coming from local organizations including PSU, the City of Portland, Metro, the Oregon Department of Transportation, Cycle Oregon, and Alta Planning + Design. Isa Swain, a former summer camp participant and current PSU student, participated as a camp counselor.

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 7,289 subscribers, as well as social media channels on Twitter, Facebook, YouTube, and LinkedIn. These efforts are described in more detail in sections 1.2.4, 3.1 and 3.2.

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

We are working to close out the grant and finish up projects. Our focus for the next year is on supporting students, technology transfer and disseminating research results.

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?

We work closely with external partners to transfer knowledge and to connect practice with academia through our transportation seminars, webinars and workshops. During this reporting period, we worked with the numerous partner organizations including: Dallas Area Rapid Transit, Portland Bureau of Transportation, Washington Department of Transportation, Metro, TriMet, Federal Highway Administration, city of Sisters, Utah Department of Transportation. Collaboration consisted of transferring knowledge through webinars, guest speakers for webinars, seminars and classes, and engaging in research.

From our report downloads survey, we know that our research reaches across end users nationally. During this reporting period, stakeholders and end users from 27 different states and Canadian Provinces downloaded our research reports.

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

Seventy-one papers based on research from this grant have been published in peer-reviewed journals, including seven during this reporting period. They have been cited 797 times (Appendix, Table 9). Some examples of articles and presentations are below:

A new article in the July 2023 issue of *Transportation Research Record: Journal of the Transportation Research Board* reports that rather than replacing conventional bike data sources and count programs, old "small" data sources will likely be very important for big data sources like Strava and StreetLight to achieve their potential for predicting annual average daily bicycle traffic (AADBT). The article, "Evaluating the Potential of Crowdsourced Data to Estimate Network-Wide Bicycle Volumes," was authored by TREC researchers Joe Broach, Sirisha Kothuri and Nathan McNeil of Portland State University along with Md Mintu Miah, Kate Hyun and Stephen Mattingly of the University of Texas at Arlington, and other collaborators from the University of North Carolina, Chapel Hill; and Frank Proulx Consulting, LLC.

University of Arizona graduate student Chandler Smith was lead author on the publication "Making of home: Transportation mobility and well-being among Tucson refugees" in the *Journal of Transport Geography* article.

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: 3,995 Followers): We promote NITC-sponsored research, publications, and events while also uplifting the activities of fellow UTCs. We share news and achievements from NITC-funded students, faculty, and ongoing projects.
- NITC UTC twitter 774 Followers, +25) offers more effective framing of the consortium partnership.
- Facebook (1,109 +4): In addition to sharing research, this platform shares photos of our events and offers connections with other organizations, researchers, and practitioners.
- YouTube (1,420 subscribers, +99): Where we publish freely accessible video recordings of weekly seminars at PSU, monthly NITC webinars, special lectures, student spotlights and more.
- LinkedIn (1,502 followers, +52): 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 (874 followers, +66): This platform introduces the people behind the research and puts a face to the center. Instagram has provided a high level of engagement, which we expect to help both our technology transfer and student recruitment efforts.

3.3 Events to support technology transfer

As described under Educating Professionals, NITC supported webinars (8) and Friday Transportation Seminars (8) that were attended by 1204 people. These events are eligible for AICP professional development credit.

3.4 Technologies or techniques

Nothing new to report.

3.5 Inventions, patent applications, and/or licenses

Nothing new to report.

3.6 Other products

Nothing new to report.

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: 3
   They included: Dallas Area Rapid Transit, Utah Transit Authority, Utah Department of Transportation

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

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

The impacts of the NITC program are achieved through interdisciplinary collaboration, our strong and intentional partner relationships, and the active participation of professionals that informs our educational offerings. Technology transfer performance measures are summarized in Table 11. Sixty-six 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.

- Number of end users reporting impact from surveys: 45
- Number of stakeholders who have adopted, implemented or deployed research findings or technologies: 34

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

NITC researchers are tapped by national media to provide context and insight on the transportation system, since the last reporting period, the following are some media highlights:

- Are electric bikes the future of green transportation? (National Geographic, June 16, 2023) (Jennifer Dill)
- E-Bikes Are Putting a Dent in Denver's Vehicle Miles Traveled (GovTech, May 22, 2023) (John MacArthur)
- A Conversation About E-Bikes With A Transportation Researcher (Cobb County Courier, May 15, 2023)(Jennifer Dill)
- The 5 Best Affordable Road Bikes, According to a Bike Mechanic (Livestrong, May 1, 2023) (Joe Broach, Jennifer Dill, John MacArthur, Nathan McNeil)
- Washington state Legislature approves e-bike incentive program (Bicycle Retailer, April 27, 2023)(John MacArthur)

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?

The commercial lidar was implemented in the NITC's funded research study was integral to understanding pedestrian behaviors and the impact of technology to improve pedestrian environments. The article Cepton Lidar Deployed in Government-funded Pedestrian Safety Projects in Texas and Utah was published in Business Wire.

NITC's e-bike studies continue to have an impact on practices and policies across the country. Here are some specific examples of practitioner and policymakers using the research results to inform e-bike policies:

- A journalist used the report to write an article for Wired on e-bikes for elders.
- It helped inform the development of a city in Maryland's e-bike incentive program.
- The report helped inform the upcoming Colorado state e-bike rebate program.
- It was used to understand the prevalence and scope of programs similar to a program being considered in the San Francisco School Access Plan.
- It helped to develop a bill to develop an e-bike incentive in New Mexico. It was mentioned that "While we may have barriers internally, your report has been instrumental in our work."
- It was used as a guiding document for Bloomington, Indiana's e-bike incentive program.
- It Informed the city of Durango e-bike rebate program.

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

In NITC project, Assessing Cool Corridor Heat Resilience Strategies for Human-Scale Transportation, researchers Ladd Keith, Nicole Iroz-Elardo and Kristina Currans of the University of Arizona assisted the City of Tuscon by evaluating "cool pavement" pilot projects. The research offers an increased knowledge of the design of cool corridor transportation infrastructure to reduce heat risk. They found

that the cool pavement treatment PlusTi asphalt rejuvenator resulted in 0.3 degrees F less ambient air temperatures observed, with no statistical difference measured. They also found that cool pavement works best in direct sunlight and not well in wind, with rougher surfaces reflecting slightly less solar radiation than smooth surfaces. Their work served to refine methodologies and analyses to encourage better integration of personal heat exposure risk in the transportation planning field and other applications.

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.

Originally launched by seed funding from NITC's predecessor, OTREC, in 2009—and supported in 2019 with additional NITC funding to replicate the program at other universities across the country—the Sustainable City Year Program (SCYP) at the University of Oregon is now starting its fourteenth year. Thanks to the hard work and support of U.S. Senators Ron Wyden and Jeff Merkley, as well as former Congressman Peter DeFazio, this year's program and work is supported by federal funding for SCYP through Congressionally Directed Spending and the US Department of Education. Thanks to additional funds from the City of Salem, Oregon, this year's partnership is poised to create a lasting impact in Oregon's second-largest city for years to come.

6 CHANGES/PROBLEMS

6.1 Changes in approach and reasons for change

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

6.2 Changes that have a significant impact on expenditures

There are no significant impacts on expenditures.

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

No significant changes.

6.4 Change of primary performance site location from that originally proposed

No updates.

7 SPECIAL REPORTING REQUIREMENTS

No requirements.

4 APPENDIX

Table 1: Initial Research Projects

Grant	Project Title	Investigators	Univ.	Status
Initial Projects	Access to Opportunities: Redefining Planning Methods and Measures for Disadvantaged Populations*	Arlie Adkins Stephen Mattingly	UA, UTA	Complete (final report pending)
	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
	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: Round 1 Research Projects

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

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

*Research projects that address equity related to mobility

Table 3: Round 2 Research Projects

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

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

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

*Research projects that address equity related to mobility

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

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

Grant	Project Title	Investigators	Univ.	Status
	Evaluation of Portland Shared E-Scooter Pilot Program Goals and Outcomes *	John MacArthur Jennifer Dill	PSU	Complete
	Scooting to a New Era in Active Transportation: Examining the Use and Safety of E-Scooters *	Kristina Currans Reid Ewing Nicole Iroz-Elardo	UA UU UA	Complete
Small Starts	Evaluating Mobility Impacts Of Construction Workzones On Utah Transportation System Using Machine Learning Techniques	Abbas Rashidi	UU	Complete
	Developing and Testing Transportation Barriers Scale and Its Impact on Mental Health Among At-risk/Homeless Youth and Emerging Adults *	Philip Baiden Godfred Boateng Stephen Mattingly	UTA	Complete
	Do Travel Costs Matter?: Using Psychological And Social Equity Perspectives To Evaluate The Effects Of A Low-income Transit Fare Program On Low-income Riders *	Liu-Qin Yang Aaron Golub Liming Wang	PSU	Complete
	E-Scooters and Public Health: Understanding the Implications of E-Scooters on Chronic Disease *	Nicole Iroz-Elardo	UA	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: Round 4 Research Projects funded by NITC in 2020

Grant	Project Title	Investigators	Univ.	Status
General Research	Understanding Connections Between Mobility, Transportation, and Quality Of Life In Refugee Communities In Tucson, Arizona *	Orhon Myadar Arlie Adkins	UA	Complete
	Data-Driven Optimization for E-Scooter System Design	Jianqiang Cheng	UA	Complete
	Understanding the Mobility Impacts of Decentralizing Homeless Services in Salt Lake County, Utah *	Sarah Canham Ivis Garcia	UU	Complete
	Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors *	Taylor Li Sirisha Kothuri	UTA PSU	Complete
	App-based Data Collection to Characterize Latent Transportation Demand within Marginalized and Underserved Populations *	Noelle Fields Courtney Cronley	UTA UTK	Complete (final report pending)
	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	Complete
	Integrate Socioeconomic Vulnerability for Resilient Transportation Infrastructure Planning *	Liming Wang John MacArthur	PSU	Complete (final report pending)
	Accessing Opportunities for Household Provisioning Post-COVID-19 *	Kelly Clifton Kristina Currans	PSU UA	Complete

*Research projects that address equity related to mobility

Table 6: Round 5 Research Projects

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

*Research projects that address equity related to mobility

Table 7: Translate Research to Practice Projects

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

Table 8. Student group activities during this reporting period

Student group	Activity	Date	# of participants
STEP (PSU)	Roadways for People book discussion with Lynn Peterson	4/7/23	11
	Advocacy Forum	4/11/23	12
	AORTA	5/9/23	13
	Engineering Orientation	9/20/23	35
ITE (OIT)	ITE Presents Chelsea Bennett, PE, KPFF Engineers "Transporting Fish!"	4/11/23	24
	APAO Careers in Roadbuilding Night	4/27/23	42
	Asphalt Pavement Alliance, Introduction to Asphalt Cracking and Rehabilitation	5/18/23	5
	Smart Growth America, Best Complete Streets Policies 2023	5/24/23	4
	Asphalt Pavement Alliance, Perpetual Pavements Sustainable by Design	6/6/23	4
Live Move (UO)	Future of Transport	04/10/23	250
	Cycling Utrecht Style	4/17, 19, 24	150
	Cycling Utrecht Style	04/18/23	25
	Cycling Utrecht Style	04/24/23	125
	Cycling Utrecht Style	04/20/23	20
	Bicycle Film Festival	05/20/23	250
	Cycle Street & Sidewalk Design	05/31/23	125
ITE (UTA)	TexITE Lubbock Meeting	4/13/2023	4
	ITS America Meeting	4/26/2023	-
	TexITE San Antonio Meeting	9/8/2023	2
	US 380 Interchange Alternatives Analysis, Timothy Cope, Bailee Allen, Burns and McDonnell	9/19/2023	15
Point B (UU)	Point B Lecture Series: Networking	04/04/2023	27
	Point B U-Walk Fest	04/11/2023	17
	NITC Students @ WMATA	01/13/2023	14
	Monthly Meetings	8/25/2023	25
	Monthly Meetings	9/15/2023	19
UA	Liam Wilson, Student "From feet to funicular: lessons learned from a tour of urban transport in europe"	4/7/2023	--
	Lynn Peterson, Becoming a changemaker: finding your path to a fulfilling, constructive career	4/21/2023	--
	Lynn Peterson, Roadways for people: building safe, just, and affordable communities	4/21/2023	--
	NITC Celebration of Research	8/29/2023	50
	UAITE Speaker Series, Currix Vision by Joe Marioni, Western Systems	9/13/2023	25
	UAITE Speaker Series, City of Tucson Downtown Links Project, Michale Barton and Brent Kirkham from HDR	10/11/2023	25

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

Publication citations (alphabetical by author) and DOIs Peer-reviewed Journals scientific, technical, or professional	# of Citations
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.	30
Broach, J., Kothuri, S., Miah, M. M., McNeil, N., Hyun, K., Mattingly, S., ... & Proulx, F. (2023). Evaluating the Potential of Crowdsourced Data to Estimate Network-Wide Bicycle Volumes. Transportation Research Record, 03611981231182388.	
Canham, S. L., Donovan, M., Rose, J., Jones, S., & Garcia, I. (2023). Transportation needs and mobility patterns of persons experiencing homelessness following shelter decentralization. Evaluation and Program Planning, 99, 102306.	1
Canham, S. L., Rose, J., Jones, S., Clay, A., & García, I. (2022). Community perspectives on how decentralising an emergency shelter influences transportation needs and use for persons experiencing homelessness. Health & Social Care in the Community, 30(6), e6645-e6655.	2
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	19
Chowdhury, F. R., Wang, P. S., & Li, P. T. (2023). Developing a tracking-based dynamic flash yellow arrow strategy for permissive left-turn vehicles to improve pedestrian safety at intersections. Journal of transportation engineering, Part A: Systems, 149(4), 04023017.	0
Clark, B. Y. (2020). THE IMPACTS OF AUTONOMOUS VEHICLES ON LOCAL GOVERNMENT BUDGETING AND FINANCE: CASE OF SOLID WASTE COLLECTION. National Tax Journal, 73(1), 259-281.	6
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	9
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.	35
Davis, J. B., Nordberg, A., Mattingly, S., Patel, M., & Leat, S. R. Transportation Among Returning Citizens: "You Just Want to Stay Down and Get High". International Journal of Offender Therapy and Comparative Criminology	0
Deitz, S. (2023). Outlier bias: AI classification of curb ramps, outliers, and context. Big Data & Society, 10(2), 20539517231203669.	
Deitz, S., Lobben, A., & Alferez, A. (2021). Squeaky wheels: Missing data, disability, and power in the smart city. Big Data & Society, 8(2)	11
Dill, J., & McNeil, N. (2022). Transit and Active Transportation Use for Non-Commute Travel Among Portland Transit-Oriented Development Residents. Transportation Research Record, 03611981221098391.	0
Ewing, R., Kim, K., Sabouri, S., Siddiq, F., & Weinberger, R. (2021). Comparative Case Studies of Parking Reduction at Transit-Oriented Developments in the USA. Transportation Research Record, 2675(1), 125-135	4
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	2
García, I., Albelson, M., Puczkowskyj, N., Khan, S. M., & Fagundo-Ojeda, K. (2022). Harassment of low-income women on transit: a photovoice project in Oregon and Utah. Transportation research part D: transport and environment, 112, 103466.	5

Publication citations (alphabetical by author) and DOIs Peer-reviewed Journals scientific, technical, or professional	# of Citations
Gehrke, S. R., & Wang, L. M. (2020). Operationalizing the neighborhood effects of the built environment on travel behavior. Journal of Transport Geography, 82.	31
Haghighi, N. N., Liu, X. C., Wei, R., Li, W. W., & Shao, H. (2018). Using Twitter data for transit performance assessment: a framework for evaluating transit riders' opinions about quality of service. Public Transport, 10(2), 363-377.	61
Hemphill, R., MacArthur, J., Longenecker, P., Desai, G., Nie, L., Ibarra, A., & Dill, J. (2022). Congested sidewalks: The effects of the built environment on e-scooter parking compliance. Journal of Transport and Land Use, 15(1), 481-495.	2
Hinners, S. J., Nelson, A. C., & Buchert, M. (2018). Streetcars and Economic Development: Do Streetcars Stimulate Employment Growth? Transportation Research Record, 2672(8), 339-350.	6
Iroz-Elardo, N., & Currans, K. Injury Burden of Introducing E-Scooters: A Review of E-Scooter Injury Studies Using Retrospective Review of Emergency Department Records, 2015-2019. Transportation Research Record	13
Iroz-Elardo, N., Adkins, A., & Ingram, M. (2021). Measuring perceptions of social environments for walking: A scoping review of walkability surveys. Health & Place, 67	23
Iuliano, J. E. (2022). Where and how Tucsonans ride and implications for cycling infrastructure. Cogent Social Sciences, 8(1), 2054127.	1
Karimpour, A., Anderson, J. C., Kothuri, S., & Wu, Y. J. Estimating pedestrian delay at signalized intersections using high-resolution event-based data: a finite mixture modeling method. Journal of Intelligent Transportation Systems	10
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.	7
Kim, J. Y., Bartholomew, K., & Ewing, R. (2020). Another one rides the bus? The connections between bus stop amenities, bus ridership, and ADA paratransit demand. Transportation Research Part a-Policy and Practice, 135, 280-288.	21
Leat, S. R., Ravi, K. E., Nordberg, A., & Schrag, R. V. (2022). Exploring the feasibility of shared mobility services for reducing transportation disadvantage among survivors of intimate partner violence. Journal of Transport & Health, 27, 101517.	0
Lee, K., Cassidy, J., Mauldin, R. L., Parekh, R., Miyawaki, C. E., Ngo, H., ... & Nguyen, K. N. (2022). Recruitment and Data Collection Challenges of Research Focused on Older Adults and Family Caregivers from Asian American Communities: A Case Study Series. Clinical Gerontologist, 1-15.	0
Lee, S., & Wang, L. (2022). Intermediate Effect of the COVID-19 Pandemic on Prices of Housing near Light Rail Transit: A Case Study of the Portland Metropolitan Area. Sustainability, 14(15), 9107.	4
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).	4
Lubitow, A., Tompkins, K., & Feldman, M. (2019). Sustainable Cycling For All? Race and Gender-Based Bicycling Inequalities in Portland, Oregon. City & Community, 18(4), 1181-1202.	39
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	8
Mashhadi, A. H., Farhadmanesh, M., Rashidi, A., & Markovic, N. Review of Methods for Estimating Construction Work Zone Capacity. Transportation Research Record	13
Maxwell, D., Mauldin, R., Thomas, J., & Holland, V. (2022). American Indian Motherhood and Historical Trauma: Keetoowah Experiences of Becoming Mothers. International Journal of Environmental Research and Public Health, 19(12), 7088.	5

Publication citations (alphabetical by author) and DOIs Peer-reviewed Journals scientific, technical, or professional	# of Citations
Miah, M. M., Hyun, K. K., Mattingly, S. P., & Khan, H. (2022). Estimation of daily bicycle traffic using machine and deep learning techniques. Transportation, 1-54.	4
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)	4
Miah, M. M., Mattingly, S. P., & Hyun, K. K. (2023). Evaluation of Bicycle Network Connectivity Using Graph Theory and Level of Traffic Stress. Journal of Transportation Engineering, Part A: Systems, 149(9), 04023080.	
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	13
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.	28
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.	3
Nahar, S., & Cronley, C. Transportation Barriers among Immigrant Women Experiencing Intimate Partner Violence. Transportation Research Record	4
Nelson, A. C. (2017). Transit and Real Estate Rents. Transportation Research Record, 2651(1), 22-30.	9
Nelson, A. C. (2017). Transit-Oriented Developments Make a Difference in Job Location. Fordham Urb. LJ, 44, 1079.	10
Nelson, A. C., Stoker, P., & Hibberd, R. (2019). Light rail transit and economic recovery: A case of resilience or transformation? Research in Transportation Economics, 74, 2-9.	8
Nordberg, A., Davis, J. B., Patel, M., Mattingly, S., & Leat, S. R. Towards a Reentry Mobilities Assemblage: An Exploration of Transportation and Obligation Among Returning Citizens. Mobilities	3
Park, K., Ewing, R., Sabouri, S., Choi, D. A., Hamidi, S., & Tian, G. Guidelines for a Polycentric Region to Reduce Vehicle Use and Increase Walking and Transit Use. Journal of the American Planning Association, 14.	46
Park, K., Sabouri, S., Lyons, T., Tian, G., & Ewing, R. (2020). Intrazonal or interzonal? Improving intrazonal travel forecast in a four-step travel demand model. Transportation, 47(5), 2087-2108	16
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	4
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.	11
Sabouri, S. (2021). Assessing polycentric development in terms of trip chaining efficiency. Cities, 117	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	9
Sleep, MD and Masley, M, (2019) Innovative and Sustainable Uses of Volcanic Ash as a Natural Pozzolan for Dust Abatement and Unpaved Roadway Improvement, Eighth International Conference on Case Histories in Geotechnical Engineering, March 24–27, 2019, Philadelphia, PA	2
Smith, C., Myadar, O., Iroz-Elardo, N., Ingram, M., & Adkins, A. (2022). Making of home: Transportation mobility and well-being among Tucson refugees. Journal of Transport Geography, 103, 103409.	5

Publication citations (alphabetical by author) and DOIs Peer-reviewed Journals scientific, technical, or professional	# of Citations
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.	2
Tan, H., McNeil, N., MacArthur, J., & Rodgers, K. (2021). Evaluation of a Transportation Incentive Program for Affordable Housing Residents. Transportation Research Record, 2675(8), 240-253.	4
Wang, P. R., Li, P. F., & Chowdhury, F. R. (2022). Development of an Adaptive Traffic Signal Control Framework for Urban Signalized Interchanges Based on Infrastructure Detectors and CAV Technologies. Journal of Transportation Engineering Part a-Systems, 148(4).	3
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.	16
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)	1
Wei, Y. D., Xiao, W. Y., & Wu, Y. Y. (2021). Trip generation, trip chains and polycentric development in metropolitan USA: A Case Study of the Wasatch Front Region, Utah. Applied Geography, 133	6
Wei, Y. D., Xiao, W. Y., Medina, R., & Tian, G. Effects of neighborhood environment, safety, and urban amenities on origins and destinations of walking behavior. Urban Geography.	10
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.	19
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.	40
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)	7
Yang, H. (2022). Assessing the Effects of New Light Rail Transit on Regional Traffic Congestion and Transit Ridership: A Synthetic Control Approach. IEEE Transactions on Intelligent Transportation Systems.	4
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.	16
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	41
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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		
District of Columbia DOT	Washington, DC	x			

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

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

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

Table 11. Technology Transfer Performance Metrics

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
Outputs	Number of final reports 71 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 81	Meet or exceed the number of presentations (KPI: 1 presentation/project) On track
	Number of events and event participants for technology transfer 43/year average 62 attendees/event	Meet or exceed number of events, professional development hours and number of attendees (KPI: 25 number of events/year with average of 50 attendees/event) Exceed
	Number of dissemination tools and products for recently completed research projects 14 briefs 4 webinars	Meet or exceed the number of dissemination tools or products per project (KPI: 1 brief/project) On track
	Number of downloads for electronic tools (databases, scripts, algorithms, etc.) 637 downloads of 10 datasets	Meet or exceed the downloads per electronic tool (KPI: 20 downloads/tool) On track
	Number of media stories covering NITC faculty, researchers and projects 27	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 - 10% Facebook - 1% YouTube - 10% LinkedIn - 26% Instagram - 8% Ongoing performance of online engagement NITC Newsletter (open rate) - 21% NITC Newsletter (click-through rate) - 20% NITC Website (# of site visitors) - 15,300	Meet or exceed our currently high averages for online engagement metrics (KPI: 10% or greater increase in new stakeholders across platforms -and- Meet or exceed baseline for ongoing online engagement NITC Newsletter (open rate) - 18.7% NITC Newsletter (click-through rate) - 19.5% NITC Website (# of site visitors) - 10,900 per 6 months On track
Outcomes	Number of stakeholders who collaborated on implementing research outcomes 10 stakeholders	Meet or exceed the number of stakeholders involved (KPI: TBD) In progress. Two is the baseline.

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
	Number of projects that reach deployment and adoption. 20 projects	Meet or exceed number of projects that reach TRL scale 4-5 (KPI: TBD) In progress. Six is the baseline.
Impacts	Number of stakeholders reporting impact from surveys Practitioners 52 Faculty/Researchers 21 Students 14 Other stakeholders 27	Meet or exceed response rate of stakeholders. (KPI: surveys) On track
	Number of stakeholders who have adopted, implemented or deployed research findings or technologies: 31	Meet or exceed number of adoptions, implementations and deployments (KPI: surveys) On track