UTC-Semi-Annual Progress Report
Portland State University

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Table of Contents

1 ACCOMPLISHMENTS: What was done? What was learned?

1.1 What are the major goals of the program?

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

Research

- **Build and extend existing research through Year 1 projects**. The first year of funding will support projects that extend some of our existing work, supplemented by a competitive peer-review process to select additional projects proposed by researchers of our consortium.

- **Competitive, peer-review project selection process in Years 2 through 5.** Our projects in Years 2 through 5 will be selected through a competitive request for proposal (RFP) process. These funds will be available for projects consistent with our theme.

- **Pooled Fund Research.** We will continue the Pooled Fund Research program which offers a process by which cities, counties, MPOs and other regional or local agencies can pool relatively small pots of research dollars to then leverage NITC matched funds for a single, collaborative project.

Leadership

- **High Standing within National and International Arenas of Transportation.** NITC faculty will continue to demonstrate leadership by disseminating their research within and outside of academia. NITC faculty help address national transportation problems through volunteer leadership on TRB committees and in other positions. By serving on these committees, faculty help set national research agendas and connect with agency leaders and practitioners on pressing research issues. To continue and reinforce this practice, NITC will mentor our new, tenure-track faculty to apply for committee and panel membership and recognize the activities of all faculty members.

- **Solving Regional and National Transportation Problems.** NITC's director and staff will serve as points of contact for agency leaders and policymakers regionally, statewide and nationally. When we identify needs that match the expertise of our researchers, we will make a connection. We will work with key staff at the DOT modal administrations, both in Washington, D.C. and within our regions, to determine the most effective way for our researchers to learn from and inform agency activities.

- **Future Leaders**. We recognize the investment we must make in our young faculty and students by prioritizing research projects that include them. We will also support students traveling to conferences to present their work, a key activity in developing the next generation of leaders.

- **Development and Delivery of Programs.** We demonstrate our leadership in innovating transportation education, workforce development, deployment of research results and conducting research.

Education and Workforce Development

- **Offer Degrees and Courses in Multiple Disciplines.** NITC university partners will continue to offer a rich array of degrees that serve the transportation profession.

- **Provide Experiential Learning.** Our campuses will continue to provide experiential learning opportunities, and NITC will seek ways to expand them.

- **Develop Innovative New Curriculum and Learning Opportunities.** We will develop 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, all were completed. However, we do not have final reports for four projects. Two of these were small starts projects; for one of those, the PI left the university before submitting a final report. They did publish a journal article based upon the research, which did acknowledge NITC funding. The paper is available to the public via open access. We were unable to get the pre-publication version of the article to use as a substitute for a final report. For the three other projects, the PIs repeatedly indicated they would submit a final report, but none were received before September 30, 2024. If they are received later, we will publish them on the NITC website. 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

During this reporting period:

- NITC Director, Jennifer Dill, chaired the planning committee for the 7th International TRB Conference on Women and Gender in Transportation that took place September 9-11, 2024. She was also named as the first Editor-in-Chief for *Transportation Research Record*, the journal of the Transportation Research Board.

- PSU researchers are leading three National Cooperative Highway Research Program (NCHRP) projects: NCHRP 07-31: State DOT and Tribal Use of Active Transportation Data: Practices, Sources, Needs, and Gaps; NCHRP 08-164: Institutional Integration of Active Transportation; and NCHRP 20-123(19): A Research Roadmap for Institutionalizing Transportation Equity

Solving Regional and National Transportation Problems

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

- The 2024 FHWA report "Separated Bike Lanes on Higher Speed Roadways: A Toolkit and Guide" cites NITC research in several areas of the report. A NITC study, "Lessons from the Green Lanes," is used to back up several statements in the report, including: "The improved safety performance of separated bike lanes compared to either no bike facility or some other type of facility is well documented. Along routes with separated bike lanes, researchers have observed a lower risk of bicyclist injuries, crashes, and falls compared to routes with no bicycle facilities." The study, conducted at PSU, examined bicyclist-motor vehicle interactions at separated bicycle lanes in five cities: Austin, TX; Chicago, IL; Portland, OR; San Francisco, CA; and Washington, D.C., and

deemed nearly all observed interactions (conflicts) precautionary after the separated bike lane installations.

- A NITC report offers lessons for post-pandemic transit policy and planning. Notably, it calls for planners to downplay the role of offices in transit station areas and increase the opportunity for people to live in them. The report includes a foreword by U.S. Congressman Earl Blumenauer. Quote from researcher UA Chris Nelson: "My last best work which is waaay too big for a refereed article but too specialized for a publisher." The report was highlighted by Smart Growth America as "a recent report offers invaluable insights on how transit-oriented development can transform our urban landscapes."

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. Over the course of the NITC grant, over 300 students have received support from NITC and graduated from their university. One recent example is Holly Querin, a spring 2024 graduate of PSU's Master of Urban and Regional Planning (MURP) program where she received a WTS Scholarship and the American Planning Association's Outstanding Student Award for PSU. She shared on LinkedIn that "I'm thrilled to have found within transportation planning a field that so clearly aligns my passions for sustainability, equity, safety, accessibility, and public health." She is now an associate transportation planner with Nelson\Nygaard Consulting Associates

NITC also supports future leaders through our student groups on each campus. During this reporting period, UTA's ITE Student Chapter was selected as one of the four finalists for the USDOT-hosted Transportation Technology Tournament (TTT). The final teams are: University of Texas at Arlington, University of Michigan, Florida International University & Florida Atlantic University, and University of Washington. As explained by faculty advisor, Taylor Li: "In general, our team proposed to use AI video analytics (developed by my research team) to identify vehicle near-misses and abnormal traffic (e.g., excessively long queues) with the city's hundreds of cameras. This proposal was endorsed by the City of Arlington (public work). Our team will be invited to present their final results during the international ITE conference in Philadelphia this July."

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 operated by the PSU Library, PDXScholar. Download data from both sources is shown in the table below for the entire grant period for products from this grant.

Downloads by type of document, grant inception to 9/30/2024			
	NITC/TREC websites	PDXScholar (library)	Total
Final report	14,799	17,991	32,790
Project brief	unknown	1,839	1,839+
Thesis/Dissertation	500	1,030	1,530
Dataset	NA	1,135	1,135

Notes: Datasets are only archived in PDXScholar. Project brief downloads from the websites are not tracked.

Downloads of final reports from the NITC project websites require downloaders to provide their email address and complete a short profile. From these data, of the people who provided information, we know that 31% of our final reports were downloaded by practitioners, 26% by students, 10% by faculty/researchers, and 25% by people indicating another category.

We also use this information to request feedback. During this period, 57 people completed surveys on NITC reports: 27 practitioners, 16 faculty/researchers, 6 students, and 8 other stakeholders. Ninety-three percent rated the reports as very or somewhat useful, and 88% rated the clarity of reports as excellent or good. We asked respondents the purpose for downloading the report and 49% of those respondents downloaded the report to help them make decisions about practice.

Data from our report download surveys for the past five years of NITC are shown in the tables below.

Who downloaded the report (2019-2024)	
Community member	1%
Faculty/Researcher	18%
Media/Communications	2%
Practitioner	43%
Student	17%
Other	19%
n	1,523

How useful was the report in meeting these purposes? (2019-2024)	
I don't know yet	16
Not useful for my intended purpose, but may be for other parts of my work	4%
Not very useful	1%
Not what I was looking for	0%
Somewhat useful	34%
Very useful	50%
No response	4%
n	1,523

What was your purpose for downloading the report? (2019-2024)	
Research proposal	6%
Research for a class or thesis	17%
Research project	18%
Inform public input process about a project	14%
I was involved in this project	3%
Help make decisions about practice	40%
Refer to a colleague	10%
Other	24%
n	1,523

How readable or clear was the report? (2019-2024)	
Don't know	6%
Excellent	47%
Good	41%
Fair	2%
No response	5%
n	1,523

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.

Students at PSU were involved in two projects as part of a partnership with Better Block PDX:

- **A Bridgeless Interval: Better Block PSU Reimagines Burnside Street.** As plans move forward for an earthquake-ready replacement of Portland's Burnside Bridge, several Portland neighborhood associations and the Better Block PSU program are taking the opportunity to reimagine a segment of West Burnside Street. In the Spring term of this year, students in a Bicycle and Pedestrian Planning course began investigating the area, outlining possible design approaches and drafting a public engagement plan. As we head into the Fall term, students in an Active Transportation Studio course will build upon that work. Students in the Spring 2024 Bicycle and Pedestrian Planning course created an existing conditions report, a public participation plan, and a set of project decisions and performance measures. Zeroing in on two locations along Burnside—the Park Blocks and Third Avenue—the team outlined several possible design approaches.
- **Better Block PSU Gives International School of Portland a Neighborhood Makeover.** Despite its proximity to popular pedestrian areas, including the Downtown Waterfront, the International School of Portland (ISP)–which serves nearly 400 students from preschool to fifth grade–can be difficult to access by foot or by bike. To provide more transportation options and give the students more access to the school's surrounding neighborhood, Portland State University students worked to improve walking and biking access to the campus. Students in a Spring Bicycle and Pedestrian Planning course created an existing conditions report, a public participation plan, and a set of project decisions and performance measures. If this project results in an easy walking connection from ISP to South Moody, it will open up brand-new transit options for parents who currently drive in from all over the metro area. "Working with the PSU students and the university has been great; everyone is very flexible and curious to find solutions. This tiny little underpass by ISP creates a great deal of congestion, so this is a chance to bring our community together around a vision and expand safe access not only to our school but to the South Waterfront," said Bodo Heiliger, Head of ISP.

Two workshop projects by students in PSU's Master of Urban and Regional Planning (MURP) program focused on transportation:

- **Future Sandy: A Multimodal Transportation Plan.** Strategic Minds Consulting Group, a team of five Portland State University Masters of Urban Planning (MURP) students, partnered with the advocacy group BikeLoudPDX to envision a future for Portland's Sandy Boulevard. The team's report highlights that Sandy Blvd is designated as a future bikeway in multiple city and regional plans, noting strong potential demand for cycling due to its diagonal layout. The students recommend reallocating lanes to reduce car traffic to one lane each way and adding parking-protected bike lanes on both sides. The report also suggests improvements to enhance accessibility for pedestrians and transit users, aiming to make the street safer and more enjoyable for traveling to its bars, restaurants, and shops. The team's promising plans for the street were featured in local media outlets including the *Portland Mercury*.
- **Hillsboro: Bike and Pedestrian Implementation Recommended Strategy.** Prepared by student team Stride Shift on behalf of the City of Hillsboro, Oregon, this project presents a contextualized Bike and Pedestrian Implementation Strategy for the City of Hillsboro. The goal was to develop an actionable approach to expand and improve the City's active transportation network. The strategy incorporates 23 criteria for project selection informed by existing

conditions and the City's priorities. Finally, the report culminates with a recommended implementation approach using two top scoring projects as examples.

Develop Innovative New Curriculum and Learning Opportunities.

Educate Professionals

During the reporting period, NITC supported 9 events that were attended by 628 people: two NITC webinars with a total of 150 attendees, four Transportation Seminars with 416 attendees and three other events with 62 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 AICP professional development credits. During this period, practitioners participated in 96 unique training events. They rated the events an average of 3.9 out of 5 stars. Since 2000, the events have a 4.0 out of 5 rating from 19,199 reviews.

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 aimed to attract and retain new undergraduate students to transportation-related degree programs and increase the number of underrepresented students in these programs. With support from FHWA's National Summer Transportation Institute program and NITC, PSU held summer camps for high school students for several years. Our follow-up surveys indicated increased understanding of and interest in transportation as a result of the camps. One attendee is now a PSU undergraduate student in civil engineering.

Examples of such engagement during this reporting period come UA, where public health undergraduate student Juliana Panhorst worked during summer 2024 with Dr. Alyssa Ryan on research related to gender safety equity and crash analysis efforts. Women are more likely than men to have more severe crash outcomes, including both resulting injuries, and fatality outcomes in crashes of similar severity. To investigate this, Panhorst supported a research project that investigated how drivers of differing genders and sexes sit in their vehicles, and how this may correlate with different injury outcomes. Panhorst and another undergraduate student, Elizabeth Smith, who is also engaged in transportation safety research with Dr. Alyssa Ryan, traveled to the ASCE Institute for Transportation and Development Conference in Atlanta, GA to learn more about the cutting-edge research in transportation happening across the globe. They participated in several sessions, including those pertaining to transit, safety, and operations research.

Attract and Support Graduate Students.

NITC supported 35 graduate students through fellowships during this reporting period, which included the 2023-24 academic year. We did not award any new dissertation fellowships to Ph.D. students during this reporting period. Three students supported by NITC completed their Ph.D. dissertations:

Adrian Cottam, University of Arizona, [Machine Learning and Big Data-Based Approaches for Quality Freeway Volumes](#). "If you boil it down, the whole purpose of my dissertation is to take existing resources that DOTs have, and try and make better use of them. For example, the Arizona Department of Transportation has loop detectors, but only in the Phoenix region. So it's a very small area out of the total land mass of Arizona. But they have other datasets, like INRIX and other crowdsourced datasets, throughout the state. So the idea of my dissertation is, can we use some of these more expensive data sets coming from the loop detectors and estimate them with some of these lower-cost and more widely available datasets?"

Traffic volume data is essential for transportation agencies for performance measurement and for implementing intelligent transportation systems (ITS) strategies. However, this data is typically collected by freeway traffic sensors, such as loop detectors. Freeway traffic sensors can be prone to failures due to communication loss or sensor failures. Furthermore, freeway traffic sensors are costly and require maintenance, making them expensive to deploy with wide spatial coverage. To address these issues with freeway traffic sensors, Cottam proposes three methodologies. The first estimates volumes for traffic sensors that have failed, ensuring ITS implementations continue to receive traffic volume data. The second estimates volumes for locations where freeway traffic sensors are unavailable. The final methodology estimates passenger car equivalency (PCE) factors for locations where freeway traffic sensors are unavailable. Two chapters of the dissertation have been published in journals: Large-Scale Freeway Traffic Flow Estimation Using Crowdsourced Data: A Case Study in Arizona and Machine-learning approach for estimating passenger car equivalent factors using crowdsourced data

Kyu Ri Kim, Portland State University. The Central Role of Perceived Safety in Connecting Crash Risk Factors and Walking Behavior. When Kyu Ri Kim was seven years old, she was struck by a car while walking in her neighborhood where there was no separate walkway for pedestrians in Seoul, South Korea. "That was the real starting point, my personal experience. And I'm curious whether other people really do understand the real risk around them. What are the crash risk factors around them and how are they different from individual perceived risk?" Kim said.

Her dissertation illuminates the relationship between pedestrian crash risk factors and perceived safety, as well as the relationship between safety attitudes and walking behavior. How the interplay between these factors influences people's behavior needs to be better understood in order to improve pedestrian safety and the walking environment. Overall, pedestrians' attitudes were mainly determined by their subjective experiences in a given environment, rather than their actual crash risk.

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

Both crash frequency analysis and real-time crash prediction models typically divide a highway into segments with a constant length for data aggregation. Despite the significant impact of the segment length, as shown in several previous traffic safety studies, no standard approach exists for determining a recommended segment length for crash data aggregation. Maniei's dissertation aims to establish a methodology for determining a recommended fragment size, which will benefit future crash frequency analysis and crash prediction models. The study attempts to capture various groups of traffic crashes, identify their corresponding hotspots, and understand their associated contributing factors. See also the journal publication: Unsupervised Approach to Investigate Urban Traffic Crashes Based on Crash Unit, Crash Severity, and Manner of Collision

1.2.3 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). All seven of the projects are complete. For example, in earlier NITC research, starting with a pooled fund project launched in 2018, researchers have been developing new approaches that combine conventional and emerging data sources to estimate bicycle volumes. Traditional permanent and short-term counting

methods have a high degree of accuracy but are limited to certain locations or short periods of time, while crowdsourced data (such as Strava or StreetLight) can cover a wider area but with less accuracy. Fusing the two methods together–potentially with the use of deep learning algorithms–is a promising way to get the best of both. Fusing the two methods together–potentially with the use of deep learning algorithms–is a promising way to get the best of both. A NITC Tech Transfer project published in during this reporting period advanced this data fusion methodology, bringing it closer to the time when agencies will be able to easily employ this method. Sirisha Kothuri of PSU, the lead researcher on the project, said "These methods are still evolving, and it's still in the research phase. But I think the time is not far off when we will start using these methods as more mainstream." In the most recent work, the researchers trained the model on existing count data from certain locations, then used that trained model to predict volumes at locations where there was count data that the model hadn't seen. They then compared the model's predictions with the actual count data to see how accurate it was. Using long short-term memory networks and deep neural networks, the method involves the combining of static variables—such as network characteristics, demographics, and land use— with dynamic crowdsourced data and count data from different regions. The research has shown that crowd-sourced data alone cannot replace traditional count data. For this method to work, it is important to have both."

Offering webinars has been an effective method for moving TREC's research into practice. Throughout the grant, we offered 82 webinars with a total of 7,979 attendees. During this reporting period, we held two webinars. Numerous practitioners that participated in the April 17, 2024 webinar (Marginalized Populations' Access to Transit) provided feedback containing insight on aspects that were most useful:

- Sisters is pursuing a multi-modal transportation hub, in which it will be an important transportation hub for community area residents and visitors. This research & presentation helps inform decisions about how this multi-modal hub is designed.
- It will help as my agency continues to partner with the transit agency to prioritize projects that make using transit feel safer for marginalized people. This was a really great presentation! I learned a lot of immediately useful information and Dr. Zapata was a really engaging speaker who didn't shy away from nuanced and complicated topic and discussion
- Designing transit stops & service for C-TRAN

Use Innovative Approaches to Communicate Research Results.

Visitors and engagement have grown across all social media platforms, the NITC website, and our newsletters. Updated daily, the NITC website saw approximately 7,000 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 stories. 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 NITC newsletter with 7,431 subscribers (23% open rate; 2.7% click-through rate) dedicated to communicating NITC research and events.

NITC's research has also been highlighted in professional publications. For example, a journal article by Chris Nelson and Robert Hibberd (UA) on "Complete Streets as a Redevelopment Strategy" was highlighted in online version of *Planning* magazine, a publication of the American Planning Association. A shorter version of online article will be in the print version of the fall issue. The spring 2024 issue of *On Common Ground*, the magazine from the National Association of Realtors highlighted work supported by NITC, including PSU's Better Block partnership (a community-engaged education program) and the comic book *Moving from Cars to People*, which communicates a wealth of research on transportation and land use through graphics and storytelling.

1.2.4 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%) involved more than one consortium partner, and over half (57%) of the research projects included investigators from more than one discipline.

1.2.5 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 had 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 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, webinars and through papers and reports. The NITC communication team delivers a quarterly newsletter on NITC research, tech transfer opportunities, and researcher accomplishments to 7,431 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?

While our grant has concluded, we will maintain the NITC website, allowing access to NITC publications. All webinars will continue to be available on TREC's YouTube channel.

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 9). 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?

Throughout the NITC grant, we worked closely with external partners to transfer knowledge and to connect practice with academia through our transportation seminars, webinars and workshops. From our report download data, we know that our research reaches across end users nationally. During this reporting period, stakeholders and end users from 46 different states and Canadian Provinces downloaded our research reports. Of the 767 NITC reports from this grant downloaded during this

reporting period, 27% were downloaded by practitioners, 25% by students, 9% by faculty/researchers, and 39% by people in other categories or unknown.

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

Eighty-four papers based on research from this grant have been published in peer-reviewed journals, including eight during this reporting period. They have been cited 1,233 times, a 24% increase over the past six months (Appendix, Table 8).

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: 3,961, Followers, -325):** 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 791 Followers, -9)** offers more effective framing of the consortium partnership.

- **Facebook (1,117 +4):** In addition to sharing research, this platform shares photos of our events and offers connections with other organizations, researchers, and practitioners.

- **YouTube (1,610 subscribers, +27)**: Where we publish freely accessible video recordings of weekly seminars at PSU, NITC webinars, special lectures, student spotlights and more.

- **LinkedIn (2,303 followers, +409):** 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 (1,011 followers, +46)**: 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.

- **Threads (372 followers, +88):** This platform is used to promote TREC research and education programs, including NITC-sponsored research, publications, and events. We also share news and achievements from students, faculty, and ongoing projects.

3.3 Events to support technology transfer

As described under Educating Professionals, NITC supported webinars (2) and Friday Transportation Seminars (4) that were attended by 566 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 during this reporting period: 3

2. Number of projects (cumulative) that reach deployment and adoption (measured by the number of projects that reach TRL scale 4 or 5): 24

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 10. As our grant is now complete, this section provides some of the recent impacts from this reporting period, as well as cumulative impacts of our projects over the entire grant period.

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

VisionEval is an open-source modeling framework used by transportation agencies all around the country to evaluate the long-term impacts of various transportation, land use, and policy scenarios. Over the past several years, NITC research has helped to refine VisionEval, incorporating new travel modes such as car sharing, bike sharing, ride hailing, and autonomous vehicles, as well as active transportation activity. Expanding the power of VisionEval offers a multitude of benefits for state and

regional planning. In addition to Liming Wang, NITC researchers Kelly Clifton, Jenny Liu, Alex Bigazzi, Yao-Jan Wu, Joseph Broach and Kristina Currans have all worked to grow VisionEval's capabilities in various ways. In existing versions of VisionEval, increases in cycling and reductions in vehicle miles traveled (VMT) were not sensitive to improvements in bicycle network connections. NITC research provided a framework that linked such infrastructure changes to bike travel, accessibility, and VMT outcomes in a way that could also be incorporated into the VisionEval planning tool. This could significantly improve the representation of bicycle travel behavior for scenario planning purposes.

A NITC research project led by Keith Bartholomew of the University of Utah and Arlie Adkins of the University of Arizona evaluated the impacts on ridership of improved facilities at bus stops along the number 41 bus line in Salt Lake City. The results had significant implications for transit agencies. The study, co-funded by the Utah Transit Authority (UTA), found a 5.9% increase in boardings after improvements were made to the series of bus stops in Salt Lake City - compared to only a 1.7% overall increase in boarding at stops in a control group that were not improved. The bus stop improvements – which include adding shelters and seating as well as stronger compliance with the Americans with Disabilities Act (ADA) – also correlated with a decrease in ADA paratransit demand in the area. These two results—increased boardings on scheduled-service buses and reductions in paratransit use—suggest that perhaps some ADA paratransit riders were switching to scheduled-bus service for at least some of their trips. To test this possibility, the team assessed how often buses were deploying their wheelchair ramps. They found that increased ramp deployments were, in fact, significantly associated with bus stops that had been improved. The changes in ADA paratransit demand, however, were much smaller in magnitude than the overall change in bus stop boardings: In other words, the data demonstrate that improved stops are appealing to riders of all abilities, not just those who qualify for ADA paratransit. These implications informed UTA's approach to bus stop improvements, and offer evidence that can support the need for increased accessibility features for other transit agencies as well. Examples of feedback from our report download survey on this project include the following:

- Working on automated driving systems for precision docking to allow ADA compliant level boarding at bus stops
- I used the report as a reference for how to better include accessibility within local transit-related plans.
- It helped us craft an inventory of bus stops and what features to assess (MPO staff person)

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?

In one example of moving research into practice, researchers at Oregon Tech paved a pilot section of trail using a NITC-developed sustainable paving method. A quarter-mile section of the Klamath Geo Trail, just east and up the hill from the Oregon Tech Klamath Falls campus, was successfully resurfaced using volcanic ash from Mount Mazama. Substituted for Portland cement, Mazama ash is a more sustainable, locally sourced pozzolan to firm up gravel roadways and trail surfaces. Building on previous work by Matthew Sleep and Damien Matzen of Oregon Tech, researchers C.J. Riley and Ashton Greer employed a Mt. Mazama volcanic ash soil amendment to improve the surface stability and firmness of the trail. The research team conducted before-and-after tests using wheelchairs and other wheeled devices, to evaluate the firmness of the trail surface. After the treatments, the surface was significantly more firm and stable, meaning that people who use mobility devices could now enjoy improved access to the natural area.

Another example of a new practice adopted based on NITC research is the deployment of Battery Electric Buses (BEBs) by the Utah Transit Authority (UTA). Cathy Liu of the University of Utah, with PSU's Aaron Golub and Ran Wei of UC Riverside, created a web-based modeling tool that enables U.S. transit providers to explore the impacts of changing over their systems to BEBs. UTA used this tool to prioritize their investments. The researchers ran the model for TriMet in Portland, OR, as well. "Bi-Objective Optimization for Battery Electric Bus Deployment Considering Cost and Environmental Equity," a paper published in Transactions on Intelligent Transportation Systems, the Institute of Electrical and Electronics Engineers (IEEE) Journal, highlights several subsequent requests to the Federal Transit Administration (FTA)'s low or no-emission grant that have been built upon this NITC research effort.

BikePed Portal is a nationwide, comprehensive non-motorized data management system for manual and automated non-vehicular multi-modal counts that is being adopted by a growing number of agencies and practitioners. BikePed Portal was established in 2015 by Transportation Research and Education Center (TREC) researchers at PSU through a NITC pooled fund project. This specialized data lake and management system makes sharing data—within an agency, with partners at other agencies, and with the public—easily accessible. Since its NITC-funded inception, it has grown into a unique national resource for bike and pedestrian data. In recent years, BikePed Portal has gained a dashboard for the national capital region and one for the Portland-Vancouver region, allowing users to see all the data for those regions in one place. It is able to accept data in multiple formats and convert them into a standardized format. Quality control tools and correction factors are also available.

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

NITC research has created and expanded awareness of the benefits of protected bicycle lanes. "Lessons From The Green Lanes" was a seminal 2014 NITC study which was the first comprehensive evaluation of protected bicycle lanes in North America, and subsequent research bears out its findings. The researchers found that bicycle ridership increased on all the studied streets with protected bike lanes added, with an average increase of 72 percent. Some survey respondents said they cycled more in general because of the new lanes. Some said they would have taken another mode of transportation, such as driving or transit, or used another route if the protected lane hadn't been there. Overall, large majorities of all road users supported adding more protected lanes. Of people living near protected bike lanes, 76 percent support adding the lanes in additional locations, whether they use them or not. Drivers thought traffic became more predictable and that fewer bicycles were mixed with motor-vehicle traffic. Most drivers said congestion and drive time didn't change; among those who did, more people thought it got worse than better. This groundbreaking study helped cities evaluate the risks and rewards of their investment in putting these facilities on the ground. Examples of feedback from our report download survey for this project include the following:

- as input to the development/evolution of our city's cycling infrastructure policies and investments
- This helped the [organization] make the case with the city for using green-backed sharrows for a Neighborhood Bikeways pilot project. The project has since been approved and funded with TIP money.
- I…will use this in consideration of changes to the Green Book and Bike Guide.
- This report was helpful in advocating for more protected bikeways with the senior staff in the city DOT where I work.
- We are looking at the state of the practice around the US to improve/change/update our design guidance in [State].

- I will be using the report as a reference as our City moves towards a friendlier community for bikers and pedestrians. I believe it is the only published report that discusses protected bike lanes by far. This feature is a potentially new bike classification in [State].
- Inform update of [MPO's] Creating Livable Streets handbook. Background research for a case study of "best practices" in the region
- Used it to help predict/estimate future bicycle ridership in a traffic study that analyzed the impacts of a proposed road diet that was being considered to incorporate a protected bike lane.
- Developing assumptions to evaluate projects based on potential VMT reduced from new or upgraded bicycle facilities.
- Education of the advocate community for the [organization] and successful passing of the council resolution to remove parking

NITC has developed a wealth of research around electric bicycles (e-bikes) to understand the potential for e-bikes to meet people's mobility needs, increase access to active transportation options, and address sustainability goals. Findings from this research have been used in policy discussions at the local, regional, state and federal level. "Estimating the Effect of E-Bikes on Person Miles Traveled and Greenhouse Gas Emissions," a white paper, found that given a 15% e-bike mode share in Portland, Oregon, the city's CO_2 emissions would be reduced by over 900 metric tons per day. The researchers conclude that the strategy of increasing e-bike mode share can be used confidently as a tool to help meet carbon emission reduction goals. The research team also created an online tool that enables policymakers, public stakeholders, and advocates to quickly visualize the potential outcomes of an electric vehicle incentive program made up of several vehicle types. The tool estimates the cost efficiency of a proposed program in terms of the cost per kg CO_2 avoided by each mode over the course of one year. A second white paper, "Using E-Bike Incentive Programs to Expand the Market," recorded trends and best practices for using e-bike incentive programs to expand the market. The researchers then developed an e-bike incentive tracker which offers an overview of the existing incentive programs in the United States and Canada, a resource for governments and clean energy advocates looking to encourage people to use e-bikes for transportation. Feedback from readers of this report include the following examples of impact:

- Helped me with development of City government ebike incentive program (still under development)
- Used the report to help inform upcoming [State] state eBike rebate program.
- Used it as a guiding document for Bloomington, Indiana's e-bike incentive program
- Helping inform [City]'s thinking on e-bike incentive program development.
- I am writing a feasibility study on accessibility to ebikes for low income communities (local government) and your policy scan of existing programmes and models was invaluable for helping inform our project
- Currently using it to craft e-bike subsidy for our locality
- My team is building out an inventory and study of EBike use and program feasibility for the [State] DOT. We are looking into issues relating to equitable access, implementation and infrastructure as a part of our study.

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. This NITC grant has supported over 300 students who have graduated. We have been able to track the careers of over two-thirds of those and found that 72% are working in the transportation field and another 5% are pursuing an additional transportation degree.

6 CHANGES/PROBLEMS

6.1 Changes in approach and reasons for change

Not applicable.

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.

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
	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
	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

*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
	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
	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	Complete
	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
	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	Complete
	Deploy LiDAR systems at intersections to improve equitable mobility	Taylor Li	UTA	Complete (final report pending)

Table 8. 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.	43
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.	3
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.	7
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.	6
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	22
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.	8
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	15
Cottam, A., Li, X., Shaon, M. R. R., & Wu, Y. J. (2024). Investigating the impacts of E-scooters on a bike-sharing system in Tucson, Arizona with a no ride zone. International Journal of Sustainable Transportation, 18(3), 250-263.	0
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.	45
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	2
Deitz, S. (2023). Outlier bias: AI classification of curb ramps, outliers, and context. Big Data & Society, 10(2), 20539517231203669.	3
Deitz, S., Lobben, A., & Alferez, A. (2021). Squeaky wheels: Missing data, disability, and power in the smart city. Big Data & Society, 8(2)	25

Publication citations (alphabetical by author) and DOIs Peer-reviewed Journals scientific, technical, or professional	# of Citations
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	6
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	4
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.	13
Gehrke, S. R., & Wang, L. M. (2020). Operationalizing the neighborhood effects of the built environment on travel behavior. Journal of Transport Geography, 82.	42
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.	76
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.	6
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.	7
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	26
Iroz-Elardo, N., Adkins, A., & Ingram, M. (2021). Measuring perceptions of social environments for walking: A scoping review of walkability surveys. Health & Place, 67	34
Iuliano, J. E. (2022). Where and how Tucsonans ride and implications for cycling infrastructure. Cogent Social Sciences, 8(1), 2054127.	2
Jones, L. R., Bennett, C., MacArthur, J. H., & Cherry, C. R. (2024). Consumer purchase response to e-bike incentives: Results from a nationwide stated preference study. Transportation Research Part D: Transport and Environment, 129, 104114.	6
Kaniewska, J., Ewing, R., Sabouri, S., & Ameli, H. (2024). Is transit-oriented development affordable for low- and moderate-income households? Cities, 147. https://doi.org/10.1016/j.cities.2023.104772	2
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	12
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.	8

Publication citations (alphabetical by author) and DOIs Peer-reviewed Journals scientific, technical, or professional	# of Citations
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.	31
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Kim, S., & Chandrasekhar, D. (2024). The impact of social networks of historically underrepresented group operators (HUGOs) business recovery. International Journal of Disaster Risk Reduction, 108, 104540.	1
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Table 9: 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 10. Technology Transfer Performance Metrics

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
Outputs	Number of final reports Research and TT projects: 75 total Dissertation fellowships: 12	Produce final report that clearly articulate research results and meet NITC standards (KPI: 1 final report/project) Missing reports on 4 projects
	Number of publications in trade/professional publications: 56 Number of journal articles: 84	Meet or exceed the number of publications (KPI: 1 publication/project) On track
	Number of presentations at national/ international and professional/trade conferences 112	Meet or exceed the number of presentations (KPI: 1 presentation/project) On track
	Number of events and event participants for technology transfer 27/year average 68 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 2 briefs (this reporting period) 2 webinars (this reporting period)	Meet or exceed the number of dissemination tools or products per project (KPI: 1 brief/project) On track for projects with final reports.
	Number of downloads for electronic tools (databases, scripts, algorithms, etc.) 1,135 downloads of 18 datasets (cumulative)	Meet or exceed the downloads per electronic tool (KPI: 20 downloads/tool) On track
	Number of media stories covering NITC faculty, researchers and projects 5 (this reporting period)	Meet or exceed the number of media stories (KPI: 30/year) On track
	Percentage increase in online engagement with new stakeholders during this reporting period: NITC Newsletter (subscribers) - 0% NITC Twitter - none Facebook <1% YouTube 2%	Meet or exceed our currently high averages for online engagement metrics (KPI: 10% or greater increase in new stakeholders across platforms On track for LinkedIn this period -and-

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
	LinkedIn 22% Instagram 5% Ongoing performance of online engagement NITC Newsletter (open rate) 23% NITC Newsletter (click-through rate) 2.7% NITC Website (# of site visitors) ~7,000	Meet or exceed baseline for ongoing online engagement On track
Outcomes	Number of stakeholders who collaborated on implementing research outcomes 14 stakeholders	Meet or exceed the number of stakeholders involved (KPI: TBD) Met. Two is the baseline.
	Number of projects that reach deployment and adoption. 23 projects	Meet or exceed number of projects that reach TRL scale 4-5 (KPI: TBD) Met. Six is the baseline.
Impacts	Number of stakeholders reporting impact from surveys Practitioners 37 Faculty/Researchers 12 Students 15 Other stakeholders 10	Meet or exceed response rate of stakeholders. (KPI: surveys) On track
	Number of stakeholders who have adopted, implemented or deployed research findings or technologies: 36	Meet or exceed number of adoptions, implementations and deployments (KPI: surveys) On track