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:

1.1.1 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.

1.1.2 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.

1.1.3 Education and Workforce Development

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

- **Attract and Support Graduate Students.** NITC will support graduate students directly through research assistantships working on projects. We will provide dissertation fellowships for students to research surface transportation topics that fit under the NITC theme. This will be a competitive process open to Ph.D. students at NITC universities multiple times throughout the year.

1.1.4 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.

1.1.5 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.

1.1.6 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 extra 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 65 research projects through General Research, Small Starts and Pooled-Fund grants. The General Research grant program supports 49 larger-scale projects. The Small Starts grant program funds researchers who have not yet had the opportunity to undertake significant transportation research. All projects have to be consistent with NITC's theme, are peer reviewed, and are selected by the NITC Executive Committee via consensus. During this reporting period, there were 44 active projects, of which 5 were completed.

1.1.6.1 Build and extend existing research through Year 1 projects.

- The 10 Initial Research Projects funded by NITC (close to $2 million) engage 22 researchers. Seven projects involved more than one partner university, demonstrating our commitment to collaboration. The 10 projects are, on average, 90% complete. (Appendix, Table 1). Six projects are complete, and their final reports are available online.

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

- **General Research:** In July 2020, 11 proposals were selected out of 43 total proposals for funding through the fourth General Research RFP (Appendix, Table 5). The awards ranged from $67,619 to $147,448 for a total of $1,142,665 in grant funding. The funding request of all proposals was $4,562,006.
  In June 2019, ten proposals were selected out of 37 total proposals for funding through the third General Research RFP (Appendix, Table 4). The selection process included prioritization for projects relating to multimodal transportation data and transportation-land use-housing interactions. The awards ranged from $53,702 to $145,650 for a total of $1,035,794 in grant funding. The funding request of all proposals was $3,803,378. Their research progress has been significantly affected by the COVID-19 pandemic. On average, the projects are 60% complete.
  In June 2018, eleven proposals were selected for funding through the second General Research RFP (Appendix, Table 3). These projects ranged from $38,049 to $149,973 for a total of $925,578. Six of the projects are complete, one's final report is being processed, and the other four are, on average, 80% complete.
- The first RFP for General Research was issued in spring 2017. Six projects were selected, ranging from $39,932 to $99,764, for a total of $437,762 (Appendix, Table 2). These projects are fully complete.
- **Small Starts:** For the third round, five proposals were selected for total funding of $99,916 in November 2019. Their progress has been slowed by the COVID-19 pandemic; they are only 40% complete. In 2018, three Small Starts projects were awarded $60,000 in funding (Appendix, Table 3). They are 100% complete. In 2017, six Small Starts projects were funded. Project budgets were approximately $20,000, for a total of $119,924 (Appendix, Table 2). Five projects are complete, and the one still active is 85% complete.

1.1.6.3 Transportation for Livable Communities Pooled Fund Research.

- NITC's Pooled Fund program offers a process by which cities, counties, MPOs and other regional or local agencies can pool relatively small pots of research dollars to then leverage NITC matched funds for a single, collaborative project. In January 2019, two Pooled Fund Projects were awarded $350,000 in funding from NITC and partners. They will be completed in 2021. Aaron Golub is the lead researcher on the Applying an Equity Lens to Automated Payment Solutions for Public Transportation project. They submitted a proposal based on our interim report to the TRB annual meeting and are awaiting feedback on that proposal. In May, they made a webinar presentation to review preliminary results to a national audience.

1.2.2 Leadership

1.1.6.4 High Standing within National and International Arenas of Transportation.

- Dr. Jennifer Dill, professor at Nohad A. Toulan School of Urban Studies & Planning, Director of the Transportation Research & Education Center, and Director of the National Institute for Transportation and Communities at Portland State University, received the 2020 Association for Pedestrian and Bicycle Professionals (APBP) "Research Professional of the Year" award for her contributions advancing the state of practice in bicycle and pedestrian research with a high degree of professional integrity.
- Chris Monsere, PSU professor of Civil Engineering, won the ITE Western District Outstanding Educator Award. He was recognized at the ITE Western District virtual meeting on Tuesday, June 30th.
- Many of the consortium's faculty members and students serve on national committees and panels and other volunteer positions. Faculty and staff served on 54 TRB volunteer committees, task forces or panels (42 committees/sections and 12 panels/task forces/workgroups). Three served in leadership positions as committee chair, and 3 as committee coordinators.

1.1.6.5 Solving Regional and National Transportation Problems

During this reporting period, NITC research has been instrumental in informing regional and national issues. Activities and progress in this goal area include:

- Two NITC researchers from UTA, Stephen Mattingly and Anne Nordberg, are leading an interdisciplinary two-year, $298,503 project, funded by the Texas Department of Transportation

(TxDOT) to develop a comprehensive vision of what the Texas transportation system should look like in 25 years.

- In September 2020, Jennifer Dill, TREC/NITC director, participated in a TRB brainstorming session on critical transportation issues related to social and racial equity issues. The purpose was to help TRB begin to identify potential social and racial issues that should be included in an addendum to its Critical Issues in Transportation 2019 document, and to help TRB identify (1) potential research projects for its cooperative research programs; (2) topics for TRB's standing technical committees to address as they plan TRB Annual Meeting sessions, issue calls for papers, plan conferences and workshops, and develop research problem statements; and (3) potential subjects for TRB to pursue as consensus policy studies.

1.1.6.6 Future Leaders.

NITC support plays a critical role in developing students and faculty as leaders in their discipline.

- Jaime Pablo Orrego-Oñate, a PSU civil engineering PhD candidate, was awarded a $15k Sylff Fellowship for International Research. The Sylff program aims to identify and nurture leaders who will overcome differences in nationality, language, ethnicity, religion, and political systems to tackle global issues, and whose high integrity and drive to address issues unique to their respective countries can make a real difference.

1.1.6.7 Development and Delivery of Programs.

Our communications team leads the way in promoting research outcomes and events of NITC, other UTCs, and other transportation agencies 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 research website. During this period, final reports were downloaded 3,565 times. During this reporting period, 279 surveys were completed by people who downloaded reports (138 practitioners, 50 faculty/researchers, 45 students, 2 media/communications staff, and 44 other stakeholders). Thirty-three percent of respondents indicated that they downloaded the report to help make decisions about practice. They heard about the research/reports from: NITC newsletter 19%, TRB website/TRID search 31%, web searches 22%, colleagues 7%, and other sources 21%. Eighty-two percent of them rated the reports as very or somewhat useful, with 78% saying the reports met their needs, and 88% rated the clarity of reports as excellent or good.

1.2.3 Education and Workforce Development

1.1.6.8 Offer Degrees and Courses in Multiple Disciplines.

The six-university consortium offers a total of 2 certificates, 13 bachelor, 22 graduate and 9 PhD programs in transportation and closely related fields, including several dual degree options. This fall, UO's School of Planning, Public Policy & Management started a new PhD program in Planning and Public Affairs. The program will include students focusing on transportation and sustainable cities. Two of the degree programs offered by the University of Utah and seven of the programs offered by the University of Texas at Arlington also receive support from other U.S. DOT-funded UTC programs.

1.1.6.9 Provide Experiential Learning.

Our campuses continue to incorporate access to community partners and employment opportunities in a number of ways. This includes the support for student groups on each of our partner campuses. Under the guidance of the Executive Committee member, each group is able to set its own agenda and priority to cater to its unique student body, goals, and interests. Unfortunately, the student group activities are usually in-person. The COVID-19 pandemic shut down in-person activities starting in March. The groups held few online activities during the spring term. A total of 10 events were attended by 127 participants (Appendix, Table 6).

NITC researcher Cathy Liu is the faculty mentor for UU's Civil and Environmental Engineering senior capstone project on professional practice and design. The six-student team is designing a six-block corridor of environmentally friendly and sustainable bike lanes for 300 West, a major street in downtown Salt Lake City. The lanes will connect existing bicycle infrastructure at the north and to the south and will be compatible with the existing built environment along the route. Their project is a partnership with Salt Lake City, which was awarded $2.8 million in state funds to design and construct the protected bike lanes along

the corridor. The students are on track to achieve their goal of having the design 40% complete by the end of the fall semester.

1.1.6.10 Develop Innovative New Curriculum and Learning Opportunities.

Over the past year, the Better Block program has identified projects for PSU planning and engineering courses. A group of six PSU Civil Engineering students spent winter and spring terms working with Portland Bureau of Transportation (PBOT) and the Community Advisory Committee (CAC) on a pop-up project designed to transform Portland's NW 13th Street into a safe street hub for businesses, residents, and multimodal transportation. The students conducted a detailed existing conditions analysis, and came up with ten alternatives for the streets which include various design elements that make the street a safer space for pedestrians and cyclists. The students used a Pugh Matrix to evaluate the alternatives and selected two to present to the clients, PBOT and CAC. Moving forward, the final design will be created by CAC and PBOT with the students' input and eventually through the permitting process.

Jennifer Dill (PSU) collaborated with transportation peer scholars Kendra Levine (UC Berkeley), and Jesus Barajas (UC Davis) to create a collaborative, crowd-sourced reading list for university curriculum to elevate anti-racism learning as well as BIPOC academic experts in the field of transportation planning and engineering. The list has been shared widely and viewed by over 300 individuals.

1.1.6.11 Educate Professionals.

During the reporting period, NITC supported 11 events that were attended by 1,545 professionals: 5 webinars attended by 612 individuals (primarily practitioners) and 6 Friday Transportation Seminars attended in person or streamed live by 933 people (mostly practitioners). 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 (https://nitc.trec.pdx.edu/events). These events are one-hour long and attendees may receive one AICP professional development credit. Viewers streamed our events from 49 states, Washington D.C., Puerto Rico, 11 Canadian provinces, and several countries. During this period, APA awarded practitioners 2,432 AICP credits, and the practitioners rated TREC's events 3.9 out of 5 stars. They also provide feedback that is useful for advising presenters of future events. For example: one reviewer let us know a webinar was "very dense and technical presentation. While I appreciate the detail and depth, there could be a benefit to a more accessible version." While another review notes: "Wonderful step-by-step presentation on this tool and these resources." Additional comments are included in the impacts section of this report. Since 2000, the events have a 4.13 out of 5 rating from over 32,000 reviews.

1.1.6.12 Attract and Support Undergraduate Students.

NITC recognizes that transportation workforce development does not always take place at the university level. Students' interest in transportation can start much earlier, which is why NITC aims to attract and retain new undergraduate students to transportation-related degree programs and increase the number of underrepresented students in these programs. The annual TURF program was cancelled due to the COVID-19 pandemic. We are working on supporting current undergraduate students while also expanding NITC's reach into the K-12 classroom through online activities.

This summer marked the fifth year of hosting the National Summer Transportation Institute (NSTI) at Portland State: one in July for Oregon high school students of all genders, and the other in August for Oregon high school girls. Both camps were held virtually this year due to state mandated stay-at-home orders and limitations on in-person gatherings due to COVID-19. Prior to the camp, the majority of students (63%) knew just a little bit or not very much about transportation. In contrast, after the camp all 27 of the students felt they knew an average to a lot about transportation. The majority of the students (82%) felt they knew a fair amount about transportation. All students indicated a higher level of interest in transportation careers after the camp.

1.1.6.13 Attract and Support Graduate Students.

NITC offers dissertation fellowships to Ph.D. students who have advanced to candidacy. This reporting period, NITC's Executive Committee reviewed proposals and awarded dissertation fellowships to four students: Robert Hibberd, UA, Sarah Robinson, UTA, Erin Murphy, UTA, and Travis Glick, PSU.

During this period, the NITC Consortium supported 55 graduate students by awarding scholarships and funding for conferences. In addition to being awarded a NITC scholarship, Kayla de Hoop, BS/MS candidate in Civil Engineering at OIT, was selected as recipient of the Dutra/Stewart Scholarship from the Beavers Charitable Trust, a scholarship valued at $12,500, with the exclusive purpose of assisting students entering the heavy construction industry. Last spring, Kayla finished her bachelor's degree in civil engineering, and this fall she began her graduate studies in civil engineering. She has held several related internships, first with Jacobs Engineering, then Oregon Department of Transportation, and Kiewit Infrastructure Engineers.

1.2.4 Technology Transfer

1.1.6.14 Move Research into Practice.

1.1.6.15 Use Innovative Approaches to Communicate Research Results.

Updated daily, the NITC website saw 10,954 site visitors during this reporting period. This was about the same as the last period. Across the board on all platforms, engagement with new readers remains low. We attribute this change to societal impacts from the global pandemic COVID-19. Although engagement hasn't grown, it has remained comparable with the previous reporting period which indicates that our core audience continues to find value in our content and research. Our highest engagement with U.S. web visitors by state is as follows: Virginia, Oregon, California, Texas, and Washington.

We continue to incorporate best practices in targeted communication, and in March launched our new online CRM (customer relationship management) database and marketing platform through HubSpot. During this reporting period we developed new forms, stakeholder engagement and outreach lists, and migrated all of our contact / subscriber data to our HubSpot CRM. When our newsletters are integrated with a robust CRM, it enables NITC staff to more effectively track and manage relationships with partners, researchers, students, alumni, and practitioners.

We published twenty-one NITC stories on research results, newly funded projects, the impact of events, and NITC Student Spotlights. The Spotlights showcase the outstanding students supported by NITC funding, including student group leaders, NITC Dissertation Fellows, and research assistants on NITC-funded projects. All of these stories are shared in our monthly NITC newsletter with 5,535 subscribers (18.7% open rate; 19.5% click-through rate) dedicated to communicating NITC research and events. The significant change in newsletter platform and act of migration of contact data / subscriber lists dictates a new baseline for performance numbers against which we can evaluate progress going forward.

1.2.5 Collaboration

1.1.6.16 Collaborating within our consortium.

NITC's governance structure is collaborative, and encourages multiple perspectives on decision-making from Executive Committee members. The Executive Committee holds quarterly teleconferences to discuss funding of projects, and address issues, particularly how to adapt to effects on research and travel due to the COVID-19 pandemic. NITC also encourages our consortium faculty to collaborate on research projects. Of the 65 research projects funded to date, 45% (29) involve more than one consortium partner. Thirty-six of the research projects (55%) included investigators from more than one discipline.

1.1.6.17 Collaborating with other UTCs.

Earlier this summer we worked with a DeafBlind consultant George Stern to give a firsthand assessment of the accessibility of our NITC final report documents. He read the report using three common screen readers-- JAWS, NVDA, and Voiceover -- and filled out an evaluation form we created. The results were both encouraging and useful. Overall, his rating of the user-friendliness of our final reports was positive, indicating that the document was easy to read and navigate. Where he did encounter problems, he made extremely helpful alternative solutions which we are able to implement. In August 2020 we reached out to the CUTC community to share our approach to advancing the accessibility of our reports, and upon request shared our internal guidance and findings in greater detail with colleagues at UC Institute of Transportation Studies. We hope to have more collaborative discussions with our peers on this subject.

Susan Handy (NCST director) and Yinhai Wang (PacTrans director) serve on the NITC Advisory Board. We support research dissemination of other UTCs through our social media on a weekly basis. Many of the peer reviewers of NITC final reports are faculty working with other UTCs.

1.1.6.18 External collaboration.

NITC Advisory Board members reviewed General Research grant proposals, and Student of the Year candidates. In addition, NITC Advisory Board members have started participating in a new online event series, "Shape Your Transportation Career: Ask Me Anything" that directly connects transportation students on NITC campuses with seasoned experts. Board Members field career questions from students about how they got into their present job - from a similar starting point as where the students are now. The first two events were hosted with Cameron Kergaye, Director of Research & Innovation at the Utah Department of Transportation and Jen Duthie, the lead Arterial Management Division (AMD) of the City of Austin Transportation Department.

1.2.6 Diversity

1.1.6.19 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 with partners that achieve this goal.

- NITC PIs are encouraged to submit Diversity project proposals to support undergraduate or graduate research assistantships for underrepresented students. During this period, Rebecca Mauldin, UTA, received funding for a diversity project which supports two graduate students working on her General Research grant. The students supported by this diversity grant will gain research experience in the research methodology of social network analysis, research study design, research ethics, data cleaning, data management, and data analysis. In addition, the students will gain knowledge of the unique characteristics of older (im)migrants' transportation experiences by working on a literature review for the project.
- PSU hosted two high-school transportation summer camps (see section 1.2.3, above). One camp served female-identified students. With the Covid-19 pandemic, we shifted these camps to a virtual format.

1.1.6.20 Priority funding to research with an equity focus.

Many of our research projects address equity (see **Appendix, Tables 1-5**) by:

- examining barriers to access, including the connections between transportation, land use, and housing;
- developing clear sets of strategies or interventions that will generate more inclusive measures of transportation behaviors;
- examining electronic wayfinding technology for visually impaired travelers;
- evaluating the impact of ADA on transit ridership and equity implications for people excluded or greatly inconvenienced by paying for transit through non-cash based collection technologies; and
- optimizing housing and service locations to provide mobility to meet the mandated obligations for former offenders to improve community health and safety.

1.3 How have the results been disseminated?

Research results are disseminated through various venues that include presentations at conferences, monthly webinars and through papers and reports. The NITC communication team delivers a monthly newsletter on NITC research, tech transfer opportunities, and researcher accomplishments to 5,535 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. One example of addressing the public on policy issues through communicating research findings outside of peer-reviewed journals is from August: John MacArthur, NITC researcher and manager of the Transportation Electrification Initiative at Portland State University was quoted in the Willamette Week, a local Portland weekly, that "there is an anti-skateboard mentality in most cities. We should be doing as much as possible to encourage these kinds of vehicles and to give them safe spaces to operate. Anything that gets people out of the car is great."

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

Expected highlights for the next reporting period include:

- Reporting on progress of funded research (research activities were slowed during this period)
- Increased activities and support for undergraduate and graduate students (activities have been limited due to Covid-19)
- Updates on tech transfer and workforce development events (online)

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 75 different partners from outside of the consortium providing matching funds, or contributions in other ways (Appendix, Table 8). This includes partners from local governments, non-profits, regional government agencies, state DOTs, transit agencies, and industry partners. The Round 4 General Research Projects awarded this summer included at least 18 new partnerships.

2.2 Have other collaborators or contacts been involved?

- The National Street Improvements Study by NITC researcher Jenny Liu, PSU, was conducted with PeopleForBikes and consulting firm Bennett Midland. The project researched the economic effects of bicycle infrastructure on 14 corridors across six cities — Portland, Seattle, San Francisco, Memphis, Minneapolis and Indianapolis. The study found that improvements such as bicycle and pedestrian infrastructure had either positive or non-significant impacts on the local economy as measured through sales and employment. The project is already having an impact on practitioners as documented in section 5.4 Bicycle Design and Planning Impacts.
- A study by NITC researchers John MacArthur and Nathan McNeil was funded by the Better Bike Share Partnership, which connected them with cities and bike share operators from across the United States. They conducted a nationwide scan on what programs and initiatives were running to address equity in bike share. The report "National Scan of Bike Share Equity Programs" documents responses from over 70 bike share systems. A recent webinar, which included Adriel Thornton from the bike share operator MoGo Detroit, discussed what they learned, best practices, and where they see the future of bike share equity programs headed.

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

Technology transfer performance measures are summarized in Table 9.

3.1 Publications, conference papers, presentations, and events

Thirty-one papers based on research from this FAST Act grant have been published in peer-reviewed journals, including five during this reporting period. They have been cited 76 times. Past research projects, supported by NITC National and Tier 1 grants, continue to result in publications. Research is also published in conference proceedings (**Appendix, Table 7**). NITC has published 26 final reports, with one-page project briefs for each final report.

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: 3,743 followers, +172):** We promote NITC-sponsored research, publications, and events while also uplifting the activities of fellow UTCs. We share news and achievements from NITC-funded students, faculty, and ongoing projects. Launched in 2019, our new NITC UTC twitter (399 followers, +63) offers more effective framing of the consortium partnership.
- **Facebook (1,010 followers, +66):** In addition to sharing research, this platform shares photos of our events and offers connection with other organizations, researchers, and practitioners.
- **YouTube (842 subscribers, +102):** Where we publish freely accessible video recordings of weekly seminars at PSU, monthly NITC webinars, special lectures, student spotlights and more.
- **LinkedIn (433 followers, +78):** 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 (470 followers, +58):** 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

During this reporting period, most events were cancelled due to COVID-19.

3.4 Technologies or techniques

Nikola Markovic's, UU, Visual Exploration of Utah Trajectory Data and their Applications in Transportation project was completed and demonstrates that INRIX trajectory data can be used to derive trip-based performance measures, which are more informative than performance measures based on average speeds computed for individual road segments. Moreover, the INRIX trajectory data can be used for more accurate estimation of traffic volumes, which is one of the key variables in measuring performance (e.g., vehicle-hour delays). They have shared interactive visualizations with UDOT and have proposed the use of CATT Lab's visual analytics tool to allow UDOT to further explore performance measures computed based on INRIX trajectories. They believe that the results will change the practice at UDOT.

3.5 Inventions, patent applications, and/or licenses

Nothing to report.

3.6 Other products

John MacArthur and Nathan McNeil's NITC tech transfer grant took key findings from their national assessment of equity bike share programs funded by Better Bike Share Partnership and created outreach material to inform bike share system operators of best practices and lessons learned related to integrating equity. Findings from the assessment will be supplemented with examples of programs, measures, and planned improvements from members of a technical advisory committee (TAC). Ten 2-page briefs on program elements were created and disseminated. The Better Bike Share Partnership launched a new website and highlighted the briefs. This project is also referenced on page 7 of the North American Bikeshare Association (NABSA) 2020 State of the Industry.

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 outcome: 9.
   They included: City of Seattle, Better Bike Share, MoGo Detroit, Wasatch Front Regional Council, Utah Transit Authority, Salt Lake County, Portland Metro, Pima County Regional Flood, City of Tucson (Tucson Water).

2. Number of projects that reach deployment and adoption (measured by the number of projects that reach TRL scale 4 or 5): 6.
   Additionally, we have identified nine projects that we believe will reach TRL scale of 4 or 5, including three of the recent 2020 General Research awards.

Attracting and retaining undergraduate and graduate students outcomes

- Ten students in UA's Planning Projects course were recognized by the American Planning Association Arizona chapter for their work with the City of Tucson on planning and policy responses to displacement and gentrification. The project and final report, Tucson Displacement Study: A Planning Study of Tucson in Neighborhoods and Displacement, were recognized as the best graduate student planning project of 2020. The course was taught by Arlie Adkins, NITC Researcher. The students also worked closely with the City of Tucson.
- UO graduate student John Larson-Friend, with the support of NITC Scholarship funding, used a combination of publicly accessible data from TransitApp and independent research to create a data visualization map of how U.S. transit agencies are responding to the impacts of COVID-19 on services, ridership, and more. In addition to an arcGIS map, John and a fellow student collaborated to analyze the data and create infographic insights into the U.S. response.

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 9. Twenty-six projects have been completed to date and we are working with stakeholders to assess the impact of the work. Impact takes time to track and assess, and many projects have not been completed long enough to measure. This section provides some of the impacts that we are now seeing from projects funded through the current and previous NITC grants (MAP-21 funds).

- Number of stakeholders reporting impact from surveys: 60
- Number of stakeholders who have adopted, implemented, or deployed research findings or technologies: 20

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

- A transportation planner at Clark County, WA, states that the Key Enhancements to the WFRC/MAG Four-Step Travel Demand Model report by Reid Ewing, UU, was used to help identify strengths and weaknesses in our current Regional Transportation Commission's travel demand model.
- A transportation planner at the City of Boston, MA, states that they were looking for examples to share with people in the community. We ended up creating our own examples but the Rethinking Streets for Bikes report by Marc Schlossberg was helpful as a starting point.
- A traffic safety program manager from Maryland DOT shared Understanding Economic and Business Impacts of Street Improvements for Bicycle and Pedestrian Mobility report by Jenny Liu with their statewide and local partners in our Strategic Highway Safety Plan team.

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 Visual Exploration of Utah Trajectory Data and their Applications in Transportation project by Nikola Markovic, UU, has led to the adoption of new practices. For example, a transportation planner at the Spokane Regional Transportation Council used the research to develop a methodology for processing and analyzing freight trajectory data to support a regional freight study. Also, a traffic modeler presented the research to data scientists, some of whom lack a traffic background, in order to show them what other transport agencies are doing.

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

- The National Academies-TRB Forum on Preparing for Automated Vehicles and Shared Mobility included the Connected Vehicle System Design for Signalized Arterials report by Terry Yang as one of their key information resources.

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:

- **Bicycle design and planning.**
  A practitioner from the North Front Range MPO (Fort Collins, CO) informs us that Jenny Liu's report Understanding Economic and Business Impacts of Street Improvements for Bicycle and Pedestrian Mobility "is helping our MPO build the case to local governments that investing in bike/ped infrastructure is a good business move." Similarly, a transportation planner for the City of St. Petersburg, FL says the report "is useful to counter arguments the city receives when vehicular parking or roadway capacity are repurposed to other uses. This shows that the argument 'it will destroy my business' is not based in fact."

  A practitioner from VHB Inc. commented on a Friday Transportation Seminar that it is a "really helpful subject. I think the compromise Portland reached with a bikeway behind a stepout area is really novel and shows a lot of promise... As bus rapid transit and bike design both become more prevalent in my work, I think this will be a method we'll certainly consider."

- **Interdisciplinary impact**
  An architect with the US Department of Fish & Wildlife used the ADA Accessible Trail Improvement with Naturally Occurring, Sustainable Materials report by Matthew Sleep, OIT, to address concerns about ADA accessibility and maintenance costs on a recently constructed compacted limerock ADA trails in Florida.

  An advocate with the Collin County Homeless Coalition is using the Promoting Environmental Justice Populations' Access to Opportunities with Suburban Boomtowns report by Jandel Crutchfield, UTA, to promote transportation solutions for people experiencing homelessness in Collin County, Texas.

- **Next generation of researchers.**
  A faculty member at the University of Kentucky incorporated Key Enhancements to the WFRC/MAG Four-Step Travel Demand Model report into the readings for a graduate planning class in Travel Demand Forecasting class.

- **Next generation of faculty.**
  N/A.

6 CHANGES/PROBLEMS

6.1 Changes in approach and reasons for change

As of March 2020, all in-person activities were suspended due to the coronavirus pandemic. This has significantly affected research timelines for our Round 3 and Small Starts 2019 projects. Most of these projects, particularly those requiring data collection, will request no-cost extensions to accommodate delays in data collection. Some organizations partnering on research projects have temporarily closed or reduced their operations. Projects that involve in-person qualitative data collection (e.g. focus groups, interviews) will try to use online approaches. Other projects may require more significant changes, such as in cases where the transportation system or behavior does not return to pre-Covid conditions. For example, one project became two projects: one is a scaled down version of the original project, and the other is studying new changes in Eugene, OR to cope with COVID-19.

Our recently awarded Round 4 General Research Projects' proposals included steps they will make to carry out their research if in-person activities are not feasible. As a result, the research should not be as affected as the previous round of projects have been.

Researchers and students are not presenting their work at many conferences that have been cancelled. NITC is trying to continue to support undergraduate and graduate students during this time, but most of their activities had been in-person.

6.2 Changes that have a significant impact on expenditures

Travel expenditures have been reduced due to travel restrictions. The annual Transportation Undergraduate Research Fellowship (TURF) Summer program for undergraduate students was not held this year. The funds are expected to be used for these purposes in 2021.

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

As noted in 6.1, social distancing is negatively affecting research projects that use in-person data collection methods.

6.4 Change of primary performance site location from that originally proposed

NITC staff and researchers are working from home. University campuses are closed to in-person meetings through Spring term.

7 SPECIAL REPORTING REQUIREMENTS

Not applicable.

Appendix

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

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

*Research projects that address equity related to mobility

Table 2: Research Projects funded by NITC in 2017

Grant	Project Title	Investigators	Univ.	Status
General Research (Round 1)	Updating and Expanding LRT/BRT/SCT/CRT Data and Analysis*	Arthur Chris Nelson	UA	Complete
	Life-Space Mobility and Aging in Place*	Ivis Garcia Zambrana Keith Dias Moore Alan DeLaTorre	UU PSU	Complete
	Understanding Factors Affecting Arterial Reliability Performance Metrics	Avinash Unnikrishnan Sirisha Kothuri	PSU	Complete
	Planning in Gateway and Amenity Communities: Understanding Unique Challenges Associated with Transportation, Mobility, and Access to Opportunity*	Danya Rumore Philip Stoker	UU UA	Complete
	Developing Data, Models, and Tools to Enhance Transportation Equity*	Amy Lubitow Julius McGee Raoul Lievanos	PSU UO	Complete
	Universally Accessible Trail Improvement with Naturally Occurring, Sustainable Materials*	Matthew Sleep	OIT	Complete
Small Starts (Round 1)	A Decentralized Network Consensus Control Approach for Urban Traffic Signal Optimization	Gerardo Lafferriere	PSU	Complete
	Is There a "Buy Local" Case for Lower Travel Speeds? Testing Differences in Driver Recognition of Local versus National Retail at Different Travel Speeds	Jonathan Bean Arlie Adkins	UA	Active
	How Will Autonomous Vehicles Change Local Government Budgeting and Finance? A Case Study of Solid Waste, Drop-off/Pick-up Zones, and Parking.	Benjamin Clark	UO	Complete
	Vehicle Sensor Data (VSD) Based Traffic Control in Connected Automated Vehicle (CAV) Environment	Xianfeng Yang	UU	Complete
	How Can Interdisciplinary Teams Leverage Emerging Technologies to Respond to Transportation Infrastructure Needs? A Mixed-Methods Evaluation of Civil Engineers, Urban Planning, and Social Workers' Perspectives.	Noelle Fields Courtney Cronley Kate Hyun Stephen Mattingly	UTA	Complete
	A Comprehensive Examination of Electronic Wayfinding Technology for Visually Impaired Travelers in an Urban Environment*	Martin Swobodzinski Amy Parker	PSU	Complete

*Research projects that address equity related to mobility

Table 3: Research Projects funded by NITC in 2018

Grant	Project Title	Investigators (Univ.)	Uni	Status
General Research (Round 2)	The Connection between Investments in Bus Stops, Ridership, and ADA Accessibility*	Keith Bartholomew Arlie Adkins	UU UA	Processing final report
	Investigating Effects of TNCs on Parking Demand and Revenues	Benjamin Clark Anne Brown	UO	Complete
	Matching the Speed of Technology with the Speed of Local Government: Developing Flexible Codes and Policies Related to the Possible Impacts of Autonomous Vehicles on Cities	Marc Schlossberg Heather Brinton	UO	Complete
	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	Active
	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	Active
	Land Use and Transportation Policies for a Sustainable Future with Autonomous Vehicles: Scenario Analysis with Simulations	Liming Wang Yao-Jan Wu	PSU UA	Active
	Emerging Technologies and Cities: Assessing the impacts of new mobility on cities	Becky Steckler Rebecca Lewis	UO	Complete
	LRT/BRT/SCT/CRT Development Outcomes FINAL PHASE	Arthur C. Nelson Kristina Currans Nicole Iroz Elardo	UA	Active
Small Starts (Round 2)	Urban Transportation System Flood Vulnerability Assessment with Special Reference to Low Income and Minority Neighborhoods*	Courtney Crosson	UA	Complete
	Promoting Environmental Justice Populations Access to Opportunities within Suburban Boomtowns: An Interdisciplinary, Mixed-Methods Approach to Addressing Infrastructure Needs*	Jandel Crutchfield	UTA	Complete
	Visual Exploration of Utah Trajectory Data and their Applications in Transportation	Nikola Markovich (UU)	UU	Complete

Grant	Project Title	Investigators (Univ.)	Uni	Status
Pooled Fund	Applying an Equity Lens to Automated Payment Solutions for Public Transportation*	Aaron Golub Jenny Liu John MacArthur Anne Brown Candace Brakewood	PSU, UO, UTK	Active
	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	Active

*Research projects that address equity related to mobility

Table 4: Research Projects funded by NITC in 2019

Grant	Project Title	Investigators	Univ.	Status
General Research (Round 3)	Is Transit-Oriented Development Affordable for Low and Moderate Income Households (in terms of H+T)?*	Reid Ewing Arlie Adkins Nicole Iroz-Elardo	UU UA	Active
	Seamless Wayfinding by Individuals with Functional Disability in Indoor and Outdoor Spaces: An Investigation into Lived Experiences, Data Needs, and Technology Requirements*	Martin Swobodzinski Amy Parker	PSU	Active
	New Mobility For All: Can Targeted Information And Incentives Help Underserved Communities Realize The Potential Of Emerging Mobility Options?*	Nathan McNeil John MacArthur Jennifer Dill	PSU	Active
	Developing Strategies To Enhance Mobility And Accessibility For Community-Dwelling Older Adults*	Kate Hyun Caroline Krejci Kathy Lee	UTA	Active
	Using Social Network Analysis To Optimize Access To Culturally Responsive And Affordable Transportation For Older (Im)Migrants*	Rebecca Mauldin Stephen Mattingly Rupal Parekh	UTA UConn	Active
	Green Waves, Machine Learning, and Predictive Analytics: Making Streets Better for People on Bike & Scooter	Marc Schlossberg Stephen Fickas	UO	Active
	Data-Driven Mobility Strategies for Multi-Modal Transportation	Yao-Jan Wu Sirisha Kothuri Xianfeng Yang	UA PSU UU	Active
	Development Of Low-Cost Radar-Based Sensor For Multi-Modal Traffic Monitoring	Siyang Cao Yao-Jan Wu	UA	Active
	Evaluation of Portland Shared E-Scooter Pilot Program Goals and Outcomes	John MacArthur Jennifer Dill	PSU	Active
	Scooting to a New Era in Active Transportation: Examining the Use and Safety of E-Scooters	Kristina Currans Reid Ewing Nicole Iroz-Elardo	UA UU UA	Active
Small Starts (Round 3)	Evaluating Mobility Impacts Of Construction Workzones On Utah Transportation System Using Machine Learning Techniques	Abbas Rashidi	UU	Active
	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	Active
	Do Travel Costs Matter?: Using Psychological And Social Equity Perspectives To Evaluate The Effects Of A Low-income Transit Fare Program On Low-income Riders	Liu-Qin Yang Aaron Golub Liming Wang	PSU	Active
	E-Scooters and Public Health: Understanding the Implications of E-Scooters on Chronic Disease	Nicole Iroz-Elardo	UA	Active
	The Impact of Ride Hail Services on the Accessibility of Nonprofit Services	Dyana Mason	UO	Active

*Research projects that address equity related to mobility

Table 5: Research Projects funded by NITC in 2020

Grant	Project Title	Investigators	Univ.	Status
General Research (Round 4)	Understanding Connections Between Mobility, Transportation, And Quality Of Life In Refugee Communities In Tucson, Arizona	Orhon Myadar Arlie Adkins	UA	Active
	Data-Driven Optimization for E-Scooter System Design	Jianqiang Cheng	UA	Active
	Understanding the Mobility Impacts of Decentralizing Homeless Services in Salt Lake County, Utah	Sarah Canham Ivis Garcia	UU	Active
	Pedestrian Behavior Study to Advance Pedestrian Safety in Smart Transportation Systems Using Innovative LIDAR Sensors	Taylor Li Sirisha Kothuri	UTA PSU	Active
	App-based Data Collection to Characterize Latent Transportation Demand within Marginalized and Underserved Populations	Noelle Fields Courtney Cronley	UTA UTK	Active
	Mobility for the People: Evaluating Equity Requirements in Shared Mobility Programs	Anne Brown Amanda Howell	UO	Active
	Statistical Inference for Multimodal Travel Time Reliability	Avinash Unnikrishnan Miguel Figliozzi	PSU	Active
	Estimating the Economic Impacts Of Transportation-Related Supply Chain Disruptions In The Post-Earthquake Environment	Divya Chandrasekhar	UU	Active
	Marginalized Populations' Access to Transit: Journeys from Home and Work to Transit	Marisa Zapata Miriam Abelson	PSU	Active
	Integrate Socioeconomic Vulnerability for Resilient Transportation Infrastructure Planning	Liming Wang John MacArthur	PSU	Active
	Accessing Opportunities for Household Provisioning Post-COVID-19	Kelly Clifton Kristina Currans	PSU UA	Active

Table 6. Student group activities during this reporting period

Student group	Activity	Date	# of participants
STEP (PSU)	Virtual recruitment meeting by STEP officers	4/21/2020	5
ITE (Oregon Tech)	Open Streets for Pedestrians during COVID presentation	5/4/2020	7
	ITE Western District Meeting, Honolulu (virtual)	6/29-30/20	6
	ITE International Meeting, New Orleans, (virtual)	8/18-20/20	4
Live Move (UO)	Transportation & Pandemics (Student-Faculty roundtable)	4/2020	15
	Local Bike Project Decision Making with Andy Kading	4/2020	20
	The Inside Scoop on Climate Action Plans w/ Kelsey Zlevor	4/2020	20
	Transportation & Pandemics (Student-Faculty roundtable)	5/2020	15
	New Mobility: Urbanism Next Conference Debrief	5/2020	15
	Future of Eugene Bikeshare	5/2020	20
ITE (UTA)	No events due to COVID-19		0
Point B (UU)	Jarrett Walker Workshop on Transit Planning - Canceled	4/1/2020	0
UA	No events due to COVID-19		0

Table 7. List of publications resulting from work funded by NITC.

Publication type	Citation	Status
Peer - reviewed Journals (scientific, technical, or professional)	Nelson, Arthur C. et al. 2017. *Transit-Oriented Developments Make a Difference in Job Location*, Fordham Urban Law Journal, Vol 44 (4), 1079-1102	Published
	Nelson, Arthur C. 2017. *Transit and Real Estate Rents*, Transportation Research Record: Journal of the Transportation Research Board, Vol 2651(5), 22-30	Published
	Hinners, S. J., Nelson, A. C., & Buchert, M. (2018). Streetcars and Economic Development: Do Streetcars Stimulate Employment Growth?. Transportation Research Record.	Published
	Nelson, A. C., Stoker, P., & Hibberd, R. (2018). Light rail transit and economic recovery: A case of resilience or transformation?. Research in Transportation Economics.	Published
	Haghighi, Nima, Xiaoyue Liu, Ran Wei, Wenwen Li, Hu Shao. Using Twitter Data for Transit Performance Assessment: A Framework for Evaluating Transit Riders' Opinions about Quality of Service. Public Transport. Vol 10, Issue 2, pp 363-377. 2018	Published
	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	Published
	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.	Published
	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.	Published
	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.	Published
	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).	Published
	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.	Published
	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.	Published
	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.	Published
	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.	Published

	Gehrke, S. R., & Wang, L. M. (2020). Operationalizing the neighborhood effects of the built environment on travel behavior. Journal of Transport Geography, 82.	Published
	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.	Published
	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.	Published
	Park, K., Ewing, R., Sabouri, S., Choi, D. A., Hamidi, S., & Tian, G. (2020). Guidelines for a Polycentric Region to Reduce Vehicle Use and Increase Walking and Transit Use. Journal of the American Planning Association, 14.	Published
	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.	Published
	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.	Published
	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.	Published
	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.	Published
	Zhang, Z., Yuan, Y., & Yang, X. F. (2020). A Hybrid Machine Learning Approach for Freeway Traffic Speed Estimation. Transportation Research Record.	Published
	Zhang, Zhao, & Yang, Xianfeng. (2020). Freeway Traffic Speed Estimation by Regression Machine-Learning Techniques Using Probe Vehicle and Sensor Detector Data. Journal of Transportation Engineering, Part A, 146(12), 2020-12-01.	Published
Peer - reviewed Published proceedings of conferences & meetings	Sleep, MD and Masley, M, (2019) Innovative and Sustainable Uses of Volcanic Ash as a Natural Pozzolan for Dust Abatement and Unpaved Roadway Improvement, Eighth International Conference on Case Histories in Geotechnical Engineering, March 24–27, 2019, Philadelphia, Pennsylvania	Published
	Nelson, Arthur C. and Keuntae Kim. 2018. Bus Rapid Transit and Economic Development: A Quasi-Experimental Treatment and Control Analysis. Meeting Compendium of Papers. Transportation Research Board.	Published
	Nelson, Arthur C. and Robert Hibberd. 2018. Analysis of the Variation in Apartment and Office Market Rents with Respect to Commuter Rail Transit Station Distance in Metropolitan San Diego and Salt Lake City. Meeting Compendium of Papers. Transportation Research Board.	Published
	Nelson Arthur C. et al. 2018. *Commuter Rail Transit and Economic Development*. Meeting Compendium of Papers. Transportation Research Board.	Published
	Nelson, Arthur C. 2018. Express Busways and Economic Development: Case Study of the Miami-Dade South Express Busway. Meeting Compendium of Papers. Transportation Research Board.	Published
	Hinners, Sarah Jack, Arthur C. Nelson, Martin Buchert. 2018. Streetcars and Equity: Case Studies of Four Streetcar Systems Assessing Change in Jobs, People and Gentrification. Annual Meeting Compendium of Papers. Transportation Research Board.	Published

	Hibberd, Robert and A.C. Nelson. 2018. *Longitudinal Cluster Analysis of Jobs-Housing Balance in Transit Neighborhoods*. Meeting Compendium of Papers. Transportation Research Board.	Published
	Nelson, Arthur C. and Robert Hibberd. 2018. Using the Real Estate Market to Establish Streetcar Catchment Areas: Case Study of Multifamily Residential Rental Property in Tucson, Arizona. Meeting Compendium of Papers. Transportation Research Board.	Published
	Nelson, Arthur C. 2018. Bus Rapid Transit and Office Rents. Annual Meeting Compendium of Papers. Transportation Research Board.	Published

Table 8: Organizations partnering with NITC projects.

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
AARP Oregon	Oregon				x[1,4]
Alliance for Walking and Biking	Washington, DC				x[1]
American Printing House for the Blind	Louisville, KY		x		
Arlington Adult Day Health Care	Arlington, TX		x		
Asian Pacific American Network of Oregon	Portland, OR		x		
Assoc. of Pedestrian Bicycle Prof.	Lexington, KY	x			x[1]
Catholic Charities of Fort Worth	Fort Worth, TX		x		
Central Lane MPO	Eugene, OR	x			
City of Arlington	Arlington, TX		x		
City of Eugene	Oregon	x			x[1]
City of Gresham	Oregon	x			
City of Irving	Irving, TX		x		x[1,4]
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			
Clevor Consulting Group	Portland, OR	x			
Colorado DOT	Denver, CO	x			
Community Action Committee	Knoxville, TN				x[2]
Concord Engineering	Utah	x			
District of Columbia DOT	Washington, DC	x			
ECONorthwest	Portland, OR	x			
Gayle Wells Foundation	Houston, TX		x		
Greenlining Institute	Oakland, CA		x		
Institute for Sustainable Solutions	Portland, OR	x			
John S. and James L. Knight Foundation	Miami, FL	x			
Lane Transit District	Eugene, OR	x			
League of American Cyclists	Washington, DC				x[1]
Living Streets Alliance	Tucson, AZ				x[4]
Metro	Portland, OR	x	x		
Metropia	Tucson, AZ		x	x	
Mid-American Regional Council	Kansas City, MI	x			
Mountainland Assoc. of Gov't	Orem, UT			x	
moovel NA	Portland, OR	x			x[1]
Multnomah County	Portland, OR				x[1,4]
Oregon DOT	Salem, OR	x	x		x[1]
OPAL Environmental Justice	Portland, OR				x[1]
PeopleforBikes	Boulder, CO	x			
Pima County DOT	Arizona	x			

Organization		Contribution Type			
Name	Location	Financial support	In-kind	Data	Other
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]
Rowell Brokaw Architects	Eugene, OR	x	x		
Resource Systems Group (RSG)	Salt Lake City, UT			x	
Rowell Brokaw Architects	Eugene, OR	x	x		x[2]
Salt Lake City Corporation	Salt Lake City, UT	x	x		
Salt Lake County Planning & Transp.	Salt Lake City, UT	x			
Sixty and Better	Fort Worth, TX		x		
Smart Growth America	Washington, DC				x[1]
St. George Area Convention and Tourism	Washington County, UT	x	x	x	
State Fair of Texas/Big Tex	Dallas, TX		x		
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		
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	

[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 9. Technology Transfer Performance Metrics

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
Outputs	Number of final reports **26 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 **31**	Meet or exceed the number of publications (KPI: 1 publication/project) **On track**
	Number of presentations at national/ international and professional/trade conferences **37**	Meet or exceed the number of presentations (KPI: 1 presentation/project) **On track**
	Number of events and event participants for technology transfer **11 events/last six months** **140 attendees/event**	Meet or exceed number of events, professional development hours and number of attendees (KPI: 25 events/year with average of 50 attendees/event) **On track**
	Number of dissemination tools and products for the 5 recently completed research projects **4 briefs** **2 webinars**	Meet or exceed the number of dissemination tools or products per project (KPI: 1 brief/project) **One brief in progress; on track.** **Reduced webinars due to COVID-19. But scheduling one for each upcoming project to be completed.**
	Number of downloads for electronic tools (databases, scripts, algorithms, etc.) **TBD**	Meet or exceed the downloads per electronic tool (KPI: 20 downloads/tool) **In progress**
	Number of media stories covering NITC faculty, researchers and projects **10 in the last six months**	Meet or exceed the number of media stories (KPI: 30/year) **On track**
	Percentage increase in online engagement with new stakeholders: NITC Newsletter (subscribers) - **N/A (new)** NITC Twitter - **19%** Facebook - **7%** YouTube - **14%** LinkedIn - **22%** Instagram - **14%** Ongoing performance of online engagement NITC Newsletter (open rate) - **18.7%** NITC Newsletter (click-through rate) - **19.5%** NITC Website (# of site visitors) - **10,954**	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** **New baselines were established*
Outcomes	Number of stakeholders who collaborated on implementing research outcomes **9 stakeholders**	Meet or exceed the number of stakeholders involved (KPI: TBD) **In progress. Two is the baseline.**

Tracking Parameter	Performance Metric	Performance Goals & Key Performance Indicators (KPI)
	Number of projects that reach deployment and adoption. **6 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 **45 Practitioners** **4 Faculty/Researchers** **11 Other stakeholders**	Meet or exceed response rate of stakeholders. (KPI: TBD) **In progress**
	Number of stakeholders who have adopted, implemented, or deployed research findings or technologies: **20**	Meet or exceed number of adoptions, implementations and deployments (KPI: TBD) **In progress**