



University Transportation Research Center - Region 2

Final Report



Utilizing Digital Exhaust from Smartphone Applications for Transportation Planning, Continuous Measurement, and Market Analysis

Performing Organization: The City University of New York (CUNY)



December 2019



Sponsor:
University Transportation Research Center - Region 2

University Transportation Research Center - Region 2

The Region 2 University Transportation Research Center (UTRC) is one of ten original University Transportation Centers established in 1987 by the U.S. Congress. These Centers were established with the recognition that transportation plays a key role in the nation's economy and the quality of life of its citizens. University faculty members provide a critical link in resolving our national and regional transportation problems while training the professionals who address our transportation systems and their customers on a daily basis.

The UTRC was established in order to support research, education and the transfer of technology in the field of transportation. The theme of the Center is "Planning and Managing Regional Transportation Systems in a Changing World." Presently, under the direction of Dr. Camille Kamga, the UTRC represents USDOT Region II, including New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. Functioning as a consortium of twelve major Universities throughout the region, UTRC is located at the CUNY Institute for Transportation Systems at The City College of New York, the lead institution of the consortium. The Center, through its consortium, an Agency-Industry Council and its Director and Staff, supports research, education, and technology transfer under its theme. UTRC's three main goals are:

Research

The research program objectives are (1) to develop a theme based transportation research program that is responsive to the needs of regional transportation organizations and stakeholders, and (2) to conduct that program in cooperation with the partners. The program includes both studies that are identified with research partners of projects targeted to the theme, and targeted, short-term projects. The program develops competitive proposals, which are evaluated to insure the most responsive UTRC team conducts the work. The research program is responsive to the UTRC theme: "Planning and Managing Regional Transportation Systems in a Changing World." The complex transportation system of transit and infrastructure, and the rapidly changing environment impacts the nation's largest city and metropolitan area. The New York/New Jersey Metropolitan has over 19 million people, 600,000 businesses and 9 million workers. The Region's intermodal and multimodal systems must serve all customers and stakeholders within the region and globally. Under the current grant, the new research projects and the ongoing research projects concentrate the program efforts on the categories of Transportation Systems Performance and Information Infrastructure to provide needed services to the New Jersey Department of Transportation, New York City Department of Transportation, New York Metropolitan Transportation Council, New York State Department of Transportation, and the New York State Energy and Research Development Authority and others, all while enhancing the center's theme.

Education and Workforce Development

The modern professional must combine the technical skills of engineering and planning with knowledge of economics, environmental science, management, finance, and law as well as negotiation skills, psychology and sociology. And, she/he must be computer literate, wired to the web, and knowledgeable about advances in information technology. UTRC's education and training efforts provide a multidisciplinary program of course work and experiential learning to train students and provide advanced training or retraining of practitioners to plan and manage regional transportation systems. UTRC must meet the need to educate the undergraduate and graduate student with a foundation of transportation fundamentals that allows for solving complex problems in a world much more dynamic than even a decade ago. Simultaneously, the demand for continuing education is growing – either because of professional license requirements or because the workplace demands it – and provides the opportunity to combine State of Practice education with tailored ways of delivering content.

Technology Transfer

UTRC's Technology Transfer Program goes beyond what might be considered "traditional" technology transfer activities. Its main objectives are (1) to increase the awareness and level of information concerning transportation issues facing Region 2; (2) to improve the knowledge base and approach to problem solving of the region's transportation workforce, from those operating the systems to those at the most senior level of managing the system; and by doing so, to improve the overall professional capability of the transportation workforce; (3) to stimulate discussion and debate concerning the integration of new technologies into our culture, our work and our transportation systems; (4) to provide the more traditional but extremely important job of disseminating research and project reports, studies, analysis and use of tools to the education, research and practicing community both nationally and internationally; and (5) to provide unbiased information and testimony to decision-makers concerning regional transportation issues consistent with the UTRC theme.

Project No(s):

UTRC/RF Grant No: 49198-43-28, 49198-44-28

Project Date: December 2019

Project Title: Utilizing Digital Exhaust from Smartphone Applications for Transportation Planning, Continuous Measurement, and Market Analysis

Project's Website:

<http://www.utrc2.org/research/projects/utilizing-digital-exhaust-smartphone-applications>

Principal Investigator(s):

Jonathan Peters, Ph.D

Professor

Department of Business

The College of Staten Island

2800 Victory Blvd

Staten Island, NY 10314

Tel: (718) 982-2958

Email: jpeters@mail.csi.cuny.edu

Co-Author(s):

Candace Brakewood (formerly of The City College of New York)

Assistant Professor

Dept. of Civil and Environmental Engineering

The University of Tennessee, Knoxville

851 Neyland Drive

Knoxville, TN 37996

Email: cbrakewo@utk.edu

Performing Organization:

The City University of New York (CUNY)

Sponsor(s):

University Transportation Research Center (UTRC)

To request a hard copy of our final reports, please send us an email at utrc@utrc2.org

Mailing Address:

University Transportation Research Center

The City College of New York

Marshak Hall, Suite 910

160 Convent Avenue

New York, NY 10031

Tel: 212-650-8051

Fax: 212-650-8374

Web: www.utrc2.org

Board of Directors

The UTRC Board of Directors consists of one or two members from each Consortium school (each school receives two votes regardless of the number of representatives on the board). The Center Director is an ex-officio member of the Board and The Center management team serves as staff to the Board.

City University of New York

Dr. Robert E. Paaswell - Director Emeritus of NY
Dr. Hongmian Gong - Geography/Hunter College

Clarkson University

Dr. Kerop D. Janoyan - Civil Engineering

Columbia University

Dr. Raimondo Betti - Civil Engineering
Dr. Elliott Sclar - Urban and Regional Planning

Cornell University

Dr. Huaizhu (Oliver) Gao - Civil Engineering
Dr. Richard Geddes - Cornell Program in Infrastructure Policy

Hofstra University

Dr. Jean-Paul Rodrigue - Global Studies and Geography

Manhattan College

Dr. Anirban De - Civil & Environmental Engineering
Dr. Matthew Volovski - Civil & Environmental Engineering

New Jersey Institute of Technology

Dr. Steven I-Jy Chien - Civil Engineering
Dr. Joyoung Lee - Civil & Environmental Engineering

New York Institute of Technology

Dr. Nada Marie Anid - Engineering & Computing Sciences
Dr. Marta Panero - Engineering & Computing Sciences

New York University

Dr. Mitchell L. Moss - Urban Policy and Planning
Dr. Rae Zimmerman - Planning and Public Administration

(NYU Tandon School of Engineering)

Dr. John C. Falocchio - Civil Engineering
Dr. Kaan Ozbay - Civil Engineering
Dr. Elena Prassas - Civil Engineering

Rensselaer Polytechnic Institute

Dr. José Holguín-Veras - Civil Engineering
Dr. William "Al" Wallace - Systems Engineering

Rochester Institute of Technology

Dr. James Winebrake - Science, Technology and Society/Public Policy
Dr. J. Scott Hawker - Software Engineering

Rowan University

Dr. Yusuf Mehta - Civil Engineering
Dr. Beena Sukumaran - Civil Engineering

State University of New York

Michael M. Fancher - Nanoscience
Dr. Catherine T. Lawson - City & Regional Planning
Dr. Adel W. Sadek - Transportation Systems Engineering
Dr. Shmuel Yahalom - Economics

Stevens Institute of Technology

Dr. Sophia Hassiotis - Civil Engineering
Dr. Thomas H. Wakeman III - Civil Engineering

Syracuse University

Dr. Baris Salman - Civil Engineering
Dr. O. Sam Salem - Construction Engineering and Management

The College of New Jersey

Dr. Thomas M. Brennan Jr - Civil Engineering

University of Puerto Rico - Mayagüez

Dr. Ismael Pagán-Trinidad - Civil Engineering
Dr. Didier M. Valdés-Díaz - Civil Engineering

UTRC Consortium Universities

The following universities/colleges are members of the UTRC consortium under MAP-21 ACT.

City University of New York (CUNY)
Clarkson University (Clarkson)
Columbia University (Columbia)
Cornell University (Cornell)
Hofstra University (Hofstra)
Manhattan College (MC)
New Jersey Institute of Technology (NJIT)
New York Institute of Technology (NYIT)
New York University (NYU)
Rensselaer Polytechnic Institute (RPI)
Rochester Institute of Technology (RIT)
Rowan University (Rowan)
State University of New York (SUNY)
Stevens Institute of Technology (Stevens)
Syracuse University (SU)
The College of New Jersey (TCNJ)
University of Puerto Rico - Mayagüez (UPRM)

UTRC Key Staff

Dr. Camille Kamga: *Director, Associate Professor of Civil Engineering*

Dr. Robert E. Paaswell: *Director Emeritus of UTRC and Distinguished Professor of Civil Engineering, The City College of New York*

Dr. Ellen Thorson: *Senior Research Fellow*

Penny Eickemeyer: *Associate Director for Research, UTRC*

Dr. Alison Conway: *Associate Director for Education/Associate Professor of Civil Engineering*

Andriy Blagay: *Graphic Intern*

Tierra Fisher: *Office Manager*

Dr. Sandeep Mudigonda, *Research Associate*

Dr. Rodrigue Tchamna, *Research Associate*

Dr. Dan Wan, *Research Assistant*

Bahman Moghimi: *Research Assistant;*

Ph.D. Student, Transportation Program

Patricio Vicuna: *Research Assistant*
Ph.D. Candidate, Transportation Program

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Utilizing Digital Exhaust from Smartphone Applications for Transportation Planning, Continuous Measurement, and Market Analysis		5. Report Date Dec. 30, 2019	6. Performing Organization Code
7. Author(s) Jonathan Peters, Ph.D. College of Staten Island Candace Brakewood, Ph.D, University of Tennessee, Knoxville		8. Performing Organization Report No.	
9. Performing Organization Name and Address CUNY College of Staten Island 2800 Victory Blvd. Staten Island, NY 10314		10. Work Unit No.	11. Contract or Grant No. 49198-43-28, 49198-44-28
12. Sponsoring Agency Name and Address UTRC The City College of New York, Marshak Hall 910 West 137th Street and Convent Avenue New York, NY 10031		13. Type of Report and Period Covered Final, Sept 1, 2016 – Dec. 30, 2019	14. Sponsoring Agency Code
15. Supplementary Notes			
16. Abstract The goal of this project was to take a critical look at how new technologies used by transit riders can transform transportation, particularly to assess what riders do after they obtain travel information. The smartphone application, Transit App, which provides real-time transit and shared mobility information, was used in this research. The Transit App dataset has the potential to demonstrate how real-time travel information can be used to improve transportation evaluation and planning. This research was an initial step in exploring the potential for continuous measurement tools to augment existing travel survey and operational data and also increase the information that is available to study transitory travel patterns and seasonal variation in demand and supply of transportation services. Analysis of the dataset from Transit App will serve as a demonstration for the potential of using emerging data sources from new rider technologies in the future to improve transportation outcomes.			
17. Key Words Transit App, Smartphone Application, travel survey		18. Distribution Statement	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page)	21. No of Pages 4	22. Price

Disclaimer

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. The contents do not necessarily reflect the official views or policies of the UTRC. This report does not constitute a standard, specification or regulation. This document is disseminated under the sponsorship of the US Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.

Project Title: Utilizing Digital Exhaust from Smartphone Applications for Transportation Planning, Continuous Measurement and Market Analysis

Principal Investigator: Jonathan Peters

The goal of this project was to take a critical look at how new technologies used by transit riders can transform transportation, particularly to assess what riders do after they obtain travel information. The smartphone application, Transit App, which provides real-time transit and shared mobility information, was used in this research. Transit App dataset has the potential to demonstrate how real-time travel information can be used to improve transportation evaluation and planning. This research was an initial step in exploring the potential for continuous measurement tools to augment existing travel survey and operational data and also increase the information that is available to study transitory travel patterns and seasonal variation in demand and supply of transportation services. Analysis of the dataset from Transit App will serve as a demonstration for the potential of using emerging data sources from new rider technologies in the future to improve transportation outcomes.

Two published papers resulted from this study:

Brakewood, Candace & Ghahramani, Niloofar & Peters, Jonathan & Kwak, Eun Jin & Sion, Jake. (2017). *Real-Time Riders: A First Look at User Interaction Data from the Back End of a Transit and Shared Mobility Smartphone App.*

Transportation Research Record: Journal of the Transportation Research Board. 2658. 56-63. 10.3141/2658-07. <https://doi.org/10.3141/2658-07>

Remy, Coline, Brakewood, Candace, Ghahramani, Niloofar, Kwak, Eun Jin and Peters, Jonathan.. *“Transit Information Utilization during Extreme Weather Event: An Analysis of Smartphone App Data.”*

Transportation Research Record: Journal of the Transportation Research Board. Fall 2019. <https://doi.org/10.1177%2F0361198118789953>

In addition, the research program resulted in a number of professional presentations that included:

LECTURES AND PAPERS PRESENTED

Peters and Brakewood (2019). Uber Usage in New Jersey: Evidence from Cell Phone App Use. The CUNY Graduate School - Ph.D. Program in Earth and Environmental Science, New York, New York. March 14, 2019

Remy, Brakewood, Ghahramani, Kwak, and Peters (2018). *Transit Information Utilization during an Extreme Weather Event: An Analysis of Smartphone App Data.* Poster presentation at the 97th Annual Meeting of the Transportation Research Board, Washington, DC.

Sponsors: The University Transportation Research Center, Region 2
 Completion Date: December 30, 2019
 University: The City College of New York, The College of Staten Island



Abstract: *Real-Time Riders: A First Look at User Interaction Data from the Back End of a Transit and Shared Mobility Smartphone App*

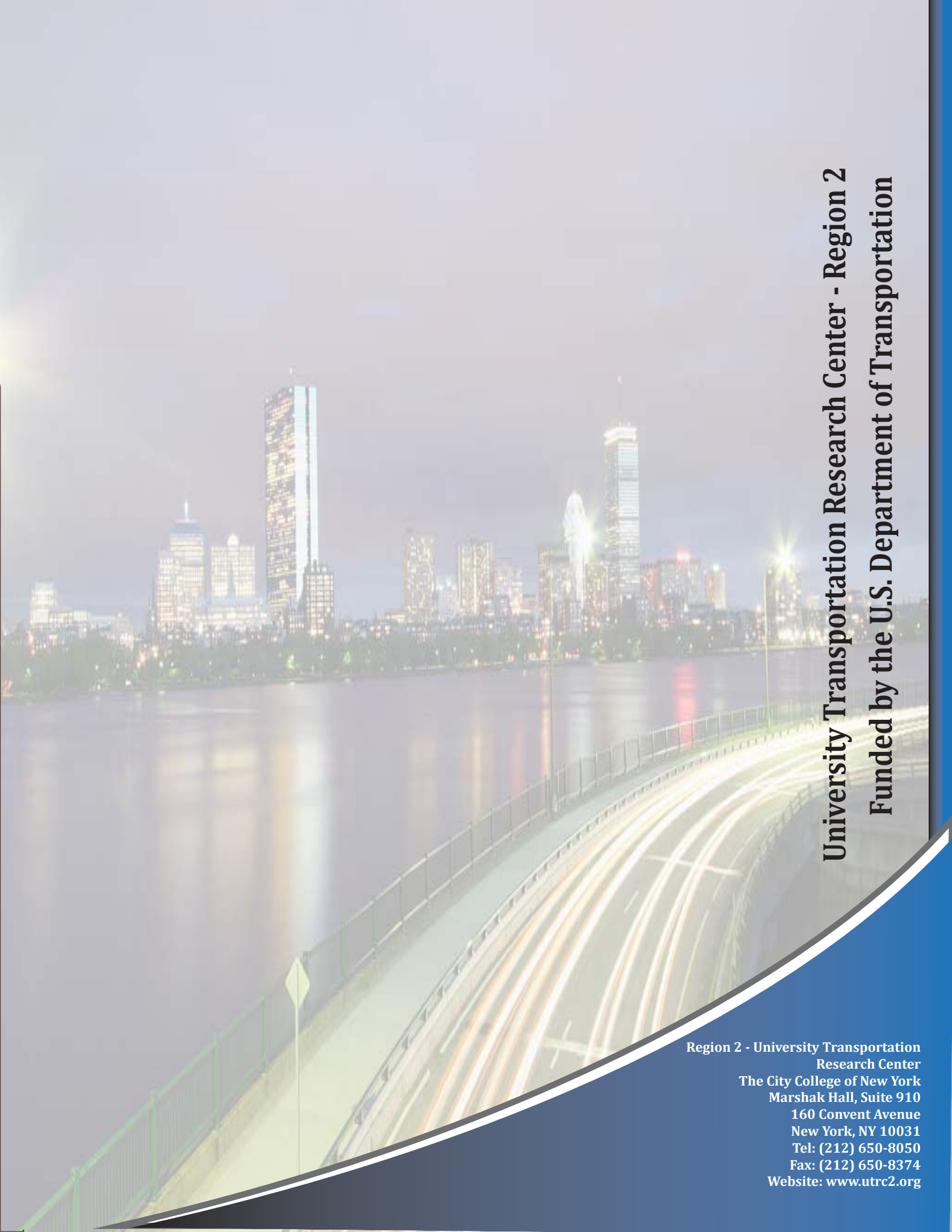
“A fundamental component of transit planning is understanding passenger travel patterns. However, traditional data sources used to study transit travel have some noteworthy drawbacks. For example, manual collection of travel surveys can be expensive, and data sets from automated fare collection systems often include only one transit system and do not capture multimodal trips (e.g., access and egress mode). New data sources from smartphone applications offer the opportunity to study transit travel patterns across multiple metropolitan regions and transit operators at little to no cost. Moreover, some smartphone applications integrate other shared mobility services, such as bikesharing, carsharing, and ride-hailing, which can provide a multimodal perspective not easily captured in traditional data sets. The objective of this research was to take a first look at an emerging data source: back-end data from user interactions with a smartphone application. The specific data set used in this paper was from a widely used smartphone application called Transit that provides real-time information about public transit and shared mobility services. Visualizations of individuals’ interactions with the Transit app were created to demonstrate three unique aspects of this data set: the ability to capture multicity transit travel, the ability to capture multiagency transit travel, and the ability to capture multimodal travel, such as the use of bikeshare to access transit. This data set was then qualitatively compared with traditional transit data sources, including travel surveys and automated fare collection data. The findings suggest that the data set has potential advantages over traditional data sources and could help transit planners better understand how passengers travel.”¹

¹ Brakewood, Candace & Ghahramani, Niloofar & Peters, Jonathan & Kwak, Eun Jin & Sion, Jake. (2017). Real-Time Riders: A First Look at User Interaction Data from the Back End of a Transit and Shared Mobility Smartphone App. *Transportation Research Record: Journal of the Transportation Research Board*. 2658. 56-63. 10.3141/2658-07.

Abstract: *Transit Information Utilization during an Extreme Weather Event: An Analysis of Smartphone App Data*

“Extreme weather events such as heavy snow can severely disrupt urban transportation systems. When this occurs, travelers often seek information about the status of transportation services. This study aims to assess information utilization during an extreme weather event by analyzing data from a smartphone application (“app”) called Transit, which provides real-time transit and shared mobility information in many cities. This research focuses on a snowstorm that hit the northeastern United States in January 2016 and severely disrupted transit and shared mobility services. An analysis of Transit app data is conducted in four parts for New York City, Philadelphia, and Washington, D.C. First, hourly app utilization during the snowstorm was compared with mean hourly app utilization prior to the storm. Second, the rate of app usage was calculated by dividing hourly utilization during the storm by the mean hourly volume before the storm. Third, an ordinary least squares regression model of hourly app usage was estimated for each city. Last, a feature within the app used to request Uber vehicles was examined. The results of the first three analyses reveal that overall app usage decreased during the snowstorm in all three cities; after the storm, New York experienced a significant increase in overall app use during the first Monday commuting period. The analysis of Uber data reveals that app users continued to search for ridehailing services during the snowstorm, despite travel bans. These findings are important for transportation operators and app developers to understand how travelers use information during extreme weather events.”²

² Remy, Coline, Brakewood, Candace, Ghahramani, Niloofar, Kwak, Eun Jin and Peters, Jonathan
“Transit Information Utilization during an Extreme Weather Event: An Analysis of Smartphone App Data”
Transportation Research Record: Journal of the Transportation Research Board., Fall 2018

A long-exposure photograph of a city skyline at night, reflected in a body of water. In the foreground, a bridge or highway has light trails from moving vehicles. The sky is dark, and the city lights are bright and colorful.

University Transportation Research Center - Region 2
Funded by the U.S. Department of Transportation

**Region 2 - University Transportation
Research Center**
The City College of New York
Marshak Hall, Suite 910
160 Convent Avenue
New York, NY 10031
Tel: (212) 650-8050
Fax: (212) 650-8374
Website: www.utrc2.org