



Program Progress Performance Report for University Transportation Center



Submitted to: U.S. Department of Transportation
Office of the Assistant Secretary for Research
and Technology (OST-R)

Grant Number: DTRT13-G-UTC60

Project Title: University Transportation Centers
Transportation Research Center for Livable
Communities (TRCLC)

Program Director: Jun-Seok Oh, Ph.D.
Professor and Director
Transportation Research Center for Livable
Communities at Western Michigan University
1903 West Michigan Avenue
Kalamazoo, MI 49008-5316
jun.oh@wmich.edu / (269) 276-3216

Submitting Official: Same as Program Director

Submission Date: September 30, 2015

DUNS and EIN: 622364479 / 386007327

Recipient Account Number: 25-7020240

Recipient Organization: Western Michigan University
1903 West Michigan Avenue
Kalamazoo, MI 49008

Project/Grant Period: September 30, 2013 – September 30, 2018

Reporting Period End Date: October 30, 2015

Report Term or Frequency: Annual

Signature of Submitting Official:

A handwritten signature in black ink that reads "Jun-Seok Oh".

1. ACCOMPLISHMENTS

1.1 *What are the major goals and objectives of the program?*

The TRCLC addresses five USDOT strategic goals through the prism of Livable Communities. The Center's primary focus is to help developing communities that provide people with access to affordable and environmentally sustainable transportation through coordination between transportation, housing, and commercial development. In particular, the Center will concentrate on "***bringing technological advances to aid the development of livable communities***" by coordinating efforts among faculty in associated fields at five universities to collectively enable livable communities through transportation research.

Research

Livable communities are where people can enjoy their daily lives without having to drive their car. Toward this end, the TRCLC focuses on three research objectives:

- improving public transit systems and alternative transportation modes,
- providing better and safer pedestrian and bicycle networks, and
- enhancing transportation accessibility for children, people with disabilities, older adults, and lower income populations.

Education and Workforce Development

The TRCLC consortium will create opportunities for learning and knowledge sharing through a comprehensive education and workforce development program based on a lifecycle of occupational development approach that emphasizes K-12 outreach, career-oriented higher education and professional development. Our program goals are to:

- 1) Develop activities for teachers, counselors, administrators and students in K-12 schools to enhance awareness of the forms and functions of transportation systems.
- 2) Develop career-oriented higher educational programs that combine multidisciplinary course work, experiential education, participative research and industry-university partnerships
- 3) Create programs for professional development on a broad range of transportation topics geared to the needs of decision-makers, transportation officials, community members and professional staff.

Technology Transfer

The Center's technology transfer program will leverage and extend our existing activities as well as build new capacity to achieve the following *inter-related goals*:

- 1) *to formalize a widely distributed and multi-format knowledge-sharing infrastructure, and*
- 2) *to create opportunities for context-sensitive problem identification and participatory research.*

Collaboration

Our primary collaborative goal is: *to develop capacities to identify, cultivate and sustain inter-disciplinary and inter-sectoral partnerships in order to meaningfully frame and address transportation problems that stifle the development of livable communities.*

Diversity

Our goal for diversity is to outreach to underrepresented groups, low income communities, and diverse disciplines and partners.

1.2 What was accomplished under these goals?

Research

- Six research projects were completed during the period.

Project ID	Title	Institution	PI
14-1	Explorations into the Equity Dimensions of US Bicycle Sharing System	WMU	Smith
14-4	Conditions that Influence Drivers' Yielding Behavior at Uncontrolled Crossings and Intersections with Traffic Signal Controls	WMU	Emerson
14-9	Alternatives for Providing a Safe Passage for Non-Motorized Traffic across an Existing Highway Bridge	WMU	Attanayake
14-10	Innovative Park-and-Ride Management for Livable Communities	USU	Song
14-11	Travel in Adverse Winter Weather conditions by Blind Pedestrians	WMU	Kim
14-12	Capacity Analysis of Pedestrian Facilities Involving Individuals with Disabilities	USU	Christensen

- There are six on-going research projects funded during the 1st funding cycle

Project ID	Title	Institution	PI
14-2	Developing Performances Measures to Capture the Effects of Transportation Facilities On Multiple Public Health Outcomes	UTA	Casey
14-3	Developing Performances Measures to Capture the Effects of Transportation Facilities On Multiple Public Health Outcomes: A Case in Michigan	WMU	Oh
14-5	Development of Decision Support Tools to Assess Pedestrian and Bicycle Safety: Development of Safety Performance Functions	WMU	Kwigizile
14-6	Development of Decision Support Tools to Assess Pedestrian and Bicycle Safety: Field Evaluation of Driver Behavior and Traffic Operations	WSU	Gates
14-7	Development of Decision Support Tools to Assess Pedestrian and Bicycle Safety: Focus on Population, Demographic and Socio-economic Spectra	TSU	Chimba
14-8	Big Data Analytics to Aid Developing Livable Communities	WMU	Yang

- The second round funding process was completed and thirteen (13) research projects were funded.

Project ID	Title	Institution	PI
15-1	Effect of Cycling Skills on Bicycle Safety and Comfort Associated with Bicycle Infrastructure and Environment	WMU	Oh
15-2	Development and Assessment of Performance Measures for Evaluating and Improving Regional Transit Coordination Using GTFS Data	WMU	Oh
15-3	Real Time Bicycle Simulation Study of Bicyclists' Behaviors and Their Implication on Safety	WMU	Kwigizile
15-4	Travel Behavior of Blind Individuals Before and After Receiving Orientation and Mobility Training	WMU	Kim
15-5	Infrastructure and Technology for Sustainable Livable Cities	WMU	Attanayake
15-6	Integrated Crowdsourcing Platform to Investigate Non-Motorized Behavior and Risk Factors on Walking, Running and Cycling Routes	WMU	Al-Fuqaha
15-7	App-Based Crowd Sourcing of Bicycle and Pedestrian Conflict Data	UTA	Mattingly
15-8	Community-Aware Charging Station Network Design for Electrified Vehicles in Urban Areas: Reducing Congestion, Emissions, Improving Accessibility and Promoting Walking, Bicycling and Use of Public Transportation	WSU	Chinnam
15-9	Impact of Access Management Practices to Pedestrian and Bicycle Operations and Safety	TSU	Chimba
15-10	Development of Multi-Class, Multi-Criteria Bicycle Traffic Assignment Models and Solution Algorithms	USU	Chen
15-11	Development of a New Combined Modal Split and Traffic Assignment Model for Evaluating Transit Oriented Development Strategies	USU	Chen
15-12	Analysis of Walking Facility Performance Guidelines for Individuals with Disabilities	USU	Christensen
15-13	Exploring Bicycle Route Choice Behavior with Space Syntax Analysis	USU	Song

Research Efforts at WMU

- Two student research projects were completed
 - Md Mehedi Hassan (Master Student), Examining the Distributive Equity of Chicago's Divvy Bike-sharing System: A comparative case study using multiple measures of accessibility, (12/14 – 08/15)
 - Xiaomeng Liu (Ph.D. Student), Longitudinal Data Analysis for Traffic Safety, (11/14 – 08/15)
- Explorations into the Equity Dimensions of US Bicycle Sharing System
 - Completed
 - Abstract: Research over the past several decades has made it increasingly clear that livable communities are inextricably linked with the provision of opportunities for active and/or non-motorized transportation;

i.e., walking, cycling and their variants. An emerging phenomena that is working within the broader movement of active transportation is public bicycle sharing systems (BSS). Such systems have grown considerably in the US in recent years and, in some cases, are dramatically changing the ecology of urban transport. Alongside celebrations of the early successes of US BSS, have been criticisms that these systems have not been adequately integrated into lower-income communities; a pattern that mirrors (motorized) transportation injustices-both past and present-that have burdened lower-income while simultaneously advantaging middle to higher-income communities. And while diverse communities are embracing non-motorized transportation, there is valid concern that traditionally underserved populations will again be marginalized or unable to share in the full benefits of existing and future bicycle- and pedestrian-oriented infrastructure including BSS. This research explores the spatial arrangements and allocations of US BSS and examines the extent to which lower-income communities experience differential access to bike-sharing infrastructure. Spatial regression models are employed to examine the degree to which race, ethnicity and/or economic hardship explain variations in the distribution of bike-sharing stations.

- Developing Performances Measures to Capture the Effects of Transportation Facilities On Multiple Public Health Outcomes: A Case in Michigan
 - Data collection metric developed
 - Initial data near schools were collected and compared
 - Socioeconomic, transportation, health data were collected for counties in Michigan
 - Developed cause and effect relationship among variables
- Conditions that Influence Drivers' Yielding Behavior at Uncontrolled Crossings and Intersections with Traffic Signal Controls
 - Completed
 - Abstract: There is a dearth of studies on how pedestrian who are blind might positively influence driver yielding in different travel situations. This project assessed common pedestrian behaviors (head turning, holding a cane, taking a step, holding up a hand, exaggerated cane movement, standing without a cane) on yielding rate for right turning traffic at lighted intersections as well as at entry and exit lanes at roundabouts. Data replicated previous findings on yielding rates for displaying a cane (about 60%), holding up a hand (65% to 80%), or taking one step into the roadway (80% to 100%) and also showed that head and gaze related behaviors do not increase yielding. In some cases, adding a head turn or gaze behavior decreases yielding rates. At the roundabout, yielding rates at exit lanes were always lower than at the entry lanes or the light controlled intersection. The outcomes have implications for O&M instruction. O&M students who benefit from a forward-facing head position to align at a crossing, or to remain aligned during a crossing, do not need to be concerned that a lack of head movement and face gaze will cause drivers to yield less often. Other students who must turn their

heads to visually monitor potential threats from turning vehicles, likewise, need not be apprehensive that their head movements or gazing will likely reduce the drivers' yielding.

- Development of Decision Support Tools to Assess Pedestrian and Bicycle Safety
 - Selected study sites for data collection
 - Stated analyzing accident data
- Big Data Analytics for Livable Communities
 - Applied the methodology of using multiresolution data aggregation as an efficient new representation of big data
 - Developed techniques and tools for interactive data visualization and statistics analysis using aggregated data as input.
 - Transformed about six terabytes of NAVTEQ Real-Time Flow Feed data for major Michigan roadways and imported them to MySQL database
 - Develop the multivariate joint models for complex longitudinal data
 - Compared aggregation data methods
 - Developed a prediction model for the number of accident using marginal mean regression models for longitudinal data
- Alternatives for Providing a Safe Passage for Non-Motorized Traffic across an Existing Highway Bridge
 - Completed
 - Abstract: Non-motorized transportation increases mobility choices, relieves congestion, promotes local economy, reduces greenhouse gas emission, promotes a healthy lifestyle, and improves quality of life. Recently, there is an emphasis on developing integrated transportation systems with off-road shared use paths and on-road facilities. A majority of highway bridges that are located on the planned or existing non-motorized paths have become bottle-necks for non-motorized traffic. Therefore, there is a need to evaluate the bridges on non-motorized paths to identify safe passage alternatives to non-motorized traffic. The owner agencies need to have access to a methodological process to evaluate a site for the best possible alternatives and develop accurate cost estimates for funding proposals. This report presents case studies, safe passage alternatives for non-motorized traffic across an existing bridge, alternative analysis methodology, analysis process, and a software platform developed to automate the analysis process. Finally, a few examples are presented to demonstrate implementation of the alternative analysis methodology.
- Travel in Adverse Winter Weather Conditions by Blind Pedestrians
 - Completed
 - Abstract: Winter weather creates many orientation and mobility (O&M) challenges for people who are visually impaired. Getting the cane tip stuck is one of the noticeable challenges when traveling in snow, particularly when the walking surface is covered in deep snow. We compared four different cane tips: 1) metal glide, 2) marshmallow roller, 3) roller ball, and 4) bundu bahser. There was a statistically significant

difference in frequency of sticking among the different cane tips. Post hoc analyses revealed that the sticking frequency for the metal glide tip was significantly higher than that for the roller ball tip, for the bundu basher tip, and for the marshmallow roller tip. In addition, there was a statistically significant difference in sticking frequency between the marshmallow roller tip and the roller ball tip. Cane tip shape appears to have contributed to differences in sticking frequency. For example, the metal glide tip, being the smallest and more sharply angled among the four cane tips, tended to get stuck on snow more often than more rounded and larger cane tips. Differences in sticking frequency among the cane tips observed in this study appear to be large enough to be practically significant for cane users and practitioners.

- Effect of Cycling Skills on Bicycle Safety and Comfort Associated with Bicycle Infrastructure and Environment
 - Started literature review and designing Instrumented Probe Bicycle
- Development and Assessment of Performance Measures for Evaluating and Improving Regional Transit Coordination Using GTFS Data
 - Reviewed GTFS data and performance measures
- Real Time Bicycle Simulation Study of Bicyclists' Behaviors and their Implication on Safety
 - Conducted literature review
 - Started building the platform for the simulator
- Integrated Crowdsourcing Platform to Investigate Non-Motorized Behavior and Risk Factors on Walking, Running and Cycling Routes
 - Analyzed existing apps
 - Conducted literature review

Research Efforts at UTA

- Established University Partnership Program with North Central Texas Council of Governments, all funded and proposed TRCLC projects may be submitted as problem statements as part of this program for matching and/or supplemental funding
- Initiated graduate student mini-grant program with local matching funds. Two projects have been awarded and a third is under review.
- Developing Performances Measures to Capture the Effects of Transportation Facilities On Multiple Public Health Outcomes
 - Developed performances measures metric for data collection
 - Collected initial data for analysis
- App-Based Crowd Sourcing of Bicycle and Pedestrian Conflict Data
 - Began developing framework

Research Efforts at USU

- Innovative Park-and-Ride Management for Livable Communities
 - Completed

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- Abstract: Park-and-ride (P&R) has been recognized as an effective way to tackle the challenge of the last-mile problem in public transportation, i.e., connecting transit stations to final destinations. Although the design and operations of P&R facilities have been extensively investigated, there is a pressing need for a theoretically sound methodology for planning and managing P&R facilities. It is critically important to investigate where P&R facilities should be strategically located and how often transit service should be provided such that the net social benefit can be maximized. This project proposes an integrated planning methodology for locating P&R facilities and designing transit services simultaneously to promote public transportation and reduce traffic externalities in urban areas. The optimal P&R facility and transit service design problem is formulated as a mathematical program with complementarity constraints, and a solution algorithm based on the active-set approach is used to solve the optimal design problem effectively. A numerical example is employed to demonstrate that the optimal design shifts commuters from the automobile mode to transit and P&R modes and, hence, improves the net social benefit dramatically. The study provides a heretofore missing theoretical framework for integrated planning of P&R facilities and transit services.
 - Capacity analysis of pedestrian facilities involving individuals with disabilities
 - Completed
 - Abstract: Walking facilities are important infrastructures that must be designed to accommodate the behavior of pedestrians in order to be effective. Heterogeneity in pedestrian composition is one important factor generally overlooked in walking facility design guidelines. Particularly, individuals with disabilities are often ignored due to lack of available data on their pedestrian behaviors. A controlled, large-scaled walking experiment involving individuals with disabilities was conducted at Utah State University to observe individual pedestrian behaviors in various walking facilities; these facilities include passageway and bottleneck formations. The purpose of this report is twofold: (1) to model time headway between different individual types using a mixed distribution model, and (2) to estimate passageway and bottleneck capacities and to identify the impacts of involving individuals with disabilities on capacity estimations. Results showed that the proposed model had good performance for pedestrian time headway modeling. Analysis also revealed that visual impaired individuals and individuals using motorized wheelchairs had the minimum and maximum capacity reduction effect on passageways and bottlenecks. The findings are expected to improve the facility capacity estimations required and to meet a preferred level-of-service for heterogeneous populations.
 - The research team developed a graphical user interface (GUI) to manage, process, and visualize the raw video data to processed pedestrian data.

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- The research team developed a framework for modeling time headway between different subpopulations of a heterogeneous pedestrian stream using a mixed distribution model.
 - The research team developed a framework for estimating facility capacities which reflect heterogeneous pedestrian populations.
 - The research team developed an integrated planning methodology for locating P&R facilities and designing transit services simultaneously to promote public transportation and reduce traffic externalities in urban areas.

Research Efforts at WSU

- Development of Decision Support Tools to Assess Pedestrian and Bicycle Safety: Field Evaluation of Driver Behavior and Traffic Operations
 - Developed behavioral data collection method for pedestrian crossings
 - Selected sites
 - Collected behavioral data at pedestrian crossings
 - 40+ sites across three cities
 - 300+ hours
- Community-Aware Charging Station Network Design for Electrified Vehicles in Urban Areas: Reducing Congestion, Emissions, Improving Accessibility and Promoting Walking, Bicycling and Use of Public Transportation
 - Reviewed extant literature on design of EV charging station networks and currently adapting them to promote livability of communities

Research Efforts at TSU

- Vehicle-pedestrian/bicycle crash data was obtained from Tennessee Roadway Information Management System (TRIMS) database maintained by Tennessee Department of Transportation (TDOT)
- Crash data that occurred in 5 years (2008-2012) in Tennessee was considered and downloaded. About 5845 pedestrian crashes and 2185 bicycle crashes has been downloaded.
- Preliminary crash data analysis was conducted through descriptive statistics to investigate the trend of crashes with respect to temporal, environmental, roadway and weather conditions.
- Demographic and socioeconomic data were obtained from United States Census Bureau website. Specifically data being used is the one provided by American Community Survey 2006-2010, five year estimates.
- GIS shapefile data was collected at a spatial unit of a block group and all subsequent analysis was conducted at this spatial unit.
- Crash data was integrated with socioeconomic and demographic data and verified.
- Conducted cluster analysis using outlier/cluster (local Moran's I) tool in GIS
- All the data were extracted as GIS shape files. The first step of this task involved verifying of the geocoding of crashes. Approximately 82% (4816) pedestrian crashes and approximately 83% (1,808) bicycle were accurately geocoded and were therefore maintained for subsequent analysis.

- Mapping of pedestrian/bicycle crashes to analyze the state-wide, county and census block group crash distribution
- Conducted cluster analysis using outlier/cluster (local Moran's I) tool in GIS
- Conducted statistical analysis using number methodologies, with the aim of determining the socioeconomic and demographic factors that influence bicycle and pedestrian crashes. The main methods that were used are; application of Bayesian networks, Artificial Neural Networks, Fuzzy Logic and Negative Binomial models.
- Crash prediction models were developed using Negative Binomial models to predict crashes of at a census block group level.
- Technical papers/reports of this task have been completed and will be presented in coming related subject/methodology conferences and submitted in related journals for publication considerations.

Education and Workforce Development

- Hosted the ITE technical session at WMU and four WMU speakers gave presentations on October 15, 2014
 - Zhanbo Sun, Trajectory-Based Vehicle Energy/Emissions Estimation for Signalized Arterials Using Mobile Sensing Data
 - Doig Ladner, Best Practice Study of Bike Friendly Universities: Sidewalks and Signage Policies
 - Matthew Clark, Performance Evaluation of ITS Corridors
 - Lusanni Rodriguez, Perception Survey on Engineering Improvement for Older Drivers
- Offered an invited speaker series on community GIS mapping on March 19
 - Speaker: Wansoo Im, President of VERTICES
 - Title: Latest GIS technology to Promote Citizen Engagement for Livable Communities
- TRCLC Partners participated as guest speakers in CORP 5430 Transportation Planning course: (1) Steve Stepek, Kalamazoo Area Transportation Study; (2) Michelle McGowen, Disability Network Southwest Michigan; (3) Zachary Vaughn, Nokia HERE; and (4) Jim Ferner, Complete Streets Coalition of Kalamazoo.
- Data collected and analyzed for the TRCLC research project were incorporated to the CORP 5430 Transportation Planning;
- CORP 5430 development of "Advancing Year-Round Accessibility in Downtown Kalamazoo: A strategic sustainable transportation plan for Disability Network Southwest Michigan"
- Students, TRCLC researcher teamed up with MDOT, City of Kalamazoo and Alta Planning to assist with data development to inform Michigan Avenue Corridor Study. Specifically, students used standardized methods to conduct pedestrian and bicycle counts at seven intersections in Kalamazoo.
- TRCLC supported graduate students to attend TRB meeting to offer their presentation opportunities.

- The American Concrete Institute (ACI) – Field Technician Grade I Certification program. Students are trained and prepared to take the exam by Dr. Upul Attanayke, P.E. Through this collaborative effort between WMU and the Michigan Concrete Association (MCA), 10 students from WMU sat for the ACI field technician grade I exam in May 2015.
- Hosted the first Livable Mobile App Challenge for high school students, and two teams won in the competition.
 - First place team: Kzoo Biking Buddy
Group Members: Kalyana Bobba, Eamaan Turk, Ryan Hansen, and Zach Marr
 - Second place team: Plug and Go (Electric Car Charging Solution)
Group Members: Kyle Wang, Katie Kring, Michael Wheeler, Shang-Bing Chang

Technology Transfer

- Updated the TRCLC website (www.wmich.edu/transportationcenter) to disseminate information on Center activities
- Continued delivering relevant information to the affiliated members, center partners and general public through the center Facebook page at www.facebook.com/TRCLC.
- Provided training sessions for high school students to help using GIS and developing mobile apps
- Professor and students presented “Advancing Year-Round Accessibility in Downtown Kalamazoo: A strategic sustainable transportation plan for Disability Network Southwest Michigan” at DNSWM Office, downtown Kalamazoo.
- Hosted the 2nd Annual Conference on Livable Communities on July 23 – 24, 2015
 - 18 podium presentations; 13 student poster presentations
 - 80 people attended

Day 1: July 23, 2015

Session	Title	Speaker
9:00 – 10:00	Registration	
Opening 10:00 – 10:20	Welcoming Remarks	Jun-Seok Oh, Director of TRCLC Dan Litynski, Vice President for Research, WMU
Session 1: 10:20 – 11:50 People with Disability and Transportation Services	[1-1] Travel in Adverse Winter Weather Conditions by Blind Pedestrians: Effect of Cane Tip Design on Travel on Snow	Dae Kim, Associate Professor, Blind and Low Vision Studies WMU
	[1-2] Impact of pedestrian gaze on yielding rates for pedestrians who are blind	Robert Wall Emersion, Professor, Blind and Low Vision Studies, WMU
	[1-3] Capacity analysis of pedestrian facilities involving individuals with disabilities	Keith Christensen, Associate Professor, Landscape Architecture and Environmental Planning, Utah State University
	[1-4] Kalamazoo County Public Transit	Sean McBride, Executive Director, Kalamazoo County Transportation

		Authority
11:50 – 1:20	Lunch & Poster Session	
1:20 – 2:20	Keynote Speech <i>Livability on Two Wheels: How to Increase Bicycling for Everyday Transportation</i>	Jenifer Dill, Director of National Institute for Transportation and Communities, Portland State University
2:20 – 2:30	Break	
Session 2 2:30 – 4:30	[2-1] Big data visual analysis in transportation	Li Yang, WMU
	[2-2] Spatial Analysis of Child Pedestrian and Bicycle Crashes in Areas Adjacent to K-8 Schools	Timothy Gates, Associate Professor, Civil Engineering, Wayne State University
	[2-3] Factors Influencing the Efficacy of the Gateway Configuration of the R1-6 Sign: An Experimental Analysis	Ron Van Houten, Professor, Psychology, WMU
	[2-4] Non-motorized Crashes and Countermeasures in Michigan	Valerian Kwigizile, Assistant Professor, Civil Engineering, WMU
	[2-5] Going zero to 70: Grand Rapids Bike Safety Education	Chris Zull, Traffic Safety Manager, City of Grand Rapids
5:30 – 8:00	Networking Dinner (Optional, own expense)	Gallagher's Eatery & Pub

Day 2: July 24, Friday

Session	Title	Speaker
7:30 – 8:15	Breakfast	
8:15 – 8:20	Welcoming Remarks	Houssam Toutanji, Dean, College of Engineering, WMU
Session 3 8:20 – 9:50	[3-1] Project Based Learning for Active Transportation	Colleen Casey, Assistant Professor, Public Policy and Public Administration, University of Texas at Arlington
	[3-2] Communities, Schools, and Students Succeeding via Safe Routes to School	Meg Thomas Ackerman, Director of Safe Routes to School at the Michigan Fitness Foundation
	[3-3] Community Engagement with a Twist	Michelle Snitgen, Active Communities Coordinator at the Michigan Fitness Foundation
	[3-4] Developing Public Health Performance Measures for Active Transportation Infrastructure	Stephen Mattingly, Associate Professor, Civil Engineering, University of Texas at Arlington
9:50 – 10:00	Break	
Session 4 10:00 –	[4-1] Kalamazoo River Valley Trail Demonstration Bikeway	Rebekah Kik & Matt Johnson, City Planner & Engineer, City of

11:50		Kalamazoo
	[4-2] Alternatives for Providing a Safe Passage for Non-motorized Traffic across an Existing Highway Bridge	Upul Attanayake, Associate Professor, & Lizmert Lopez, Graduate Student, Civil Engineering, WMU
	[4-3] Integrated Crowdsourcing Platform to Investigate Non-Motorized Behavior and Risk Factors on Walking, Running and Cycling Routes	Ala Al-Fuqaha, Professor in Computer Science, WMU
	[4-4] Confronting Equity in Bike-Sharing Systems	Scott Smith, Research Professor, TRCLC, WMU
11:50 – 12:00	Closing Remark and Best Poster Awards	Jun-Seok Oh, WMU

Collaboration

- Worked with Disability Network Southwest Michigan (DNSWM) and the City of Kalamazoo to develop “Advancing Year-Round Accessibility in Downtown Kalamazoo: A strategic sustainable transportation plan for DNSWM”
- Collaborated with Accessible Design for the Blind, which is a not-for-profit agency with the mission of improving blind individuals’ access to the environment
- Students and TRCLC researchers teamed up with MDOT, City of Kalamazoo and Alta Planning to assist with data development to inform Michigan Avenue Corridor study. Specifically, students used standardized methods to conduct pedestrian and bicycle counts at seven intersections in Kalamazoo.
- WMU research team provided technical support for the City of Kalamazoo and the Kalamazoo Township – North Street Community Livability Analysis
- UTA established University Partnership Program with North Central Texas Council of Governments, will seek opportunities to educate students and send them to NCTCOG for internship positions
- UTA research team attended Moving Active Transportation to Higher Ground Conference
- USU research team has collaborated with the Rocky Mountain ADA Center to assess and analyze the transportation access of individuals with disabilities in the intermountain west region VIII.
- USU research team has collaborated with the TOD-based Sustainable City Transportation Research Center in Korea to conduct bicycle network analysis research.
- TSU research team established collaboration with Tennessee Department of Transportation (TDOT) to access crash data
- TSU established mutual collaboration with Williamson County MPO in Tennessee for case study locations

Diversity

- A project funded by TRCLC, "Explorations into the Equity Dimensions of US Bicycle Sharing System" explores underrepresented groups and low income communities.
- TRCLC encouraged PIs to increase involvement of African American graduate students and female students, and at least three African American students and two female students were involved in projects funded from the center grant.
- Incorporated a variety of diversity-related topics into CORP 5430 Transportation Planning course including: environmental justice in transportation planning; transportation planning for people with disabilities; multimodal transportation planning to improve job accessibility and economic performance within lower income communities.
- UTA became a Hispanic serving institution.
- Three female graduate students at WMU were recruited by TRCLC, and one of the female graduate students is Hispanic.
- Four African American graduate students at TSU are supported by the TRCLC grant, and one female student is involved.

1.3 What opportunities for training and professional development has the program provided?

- Hosted the second annual summer conference on livable communities. A total of 13 podium presentations and 12 poster presentations were offered to 80 researchers and practitioners.
- Organized and hosted ITE Michigan technical sessions on at WMU October 15, and four WMU speakers gave presentations.
- A mobile app competition for high school students in Michigan was initiated, and two teams selected were awarded by TRCLC.
- TRCLC invited local high school students and offered two technical training sessions on using GIS and mobile web development.
- Invited talk by Dr. Wansoo Im, President of VERTICES. Latest GIS technology to Promote Citizen Engagement for Livable Communities. WMU, Kalamazoo, MI, March 19, 2015 (60 attendees)
- USU hosted an Institute of Transportation Engineers (ITE) Seminars (Utah)
- Brian Christensen from Horrocks Engineers in Pleasant Grove, Utah on March 4, 2015. (10 attendees)
- Jenny Grote, the Deputy Street Transportation Director at City of Phoenix, Arizona, and the international director on the ITE International Board, March 30, 2015: (40 attendees)
- Wulf Grote, the Director of Planning and Development for Valley Metro, Phoenix, Arizona on March 30, 2015: (40 attendees)
- April 6, 2015: Kevin Griffin, UDOT Maintenance Division Director. (40 attendees).
- WSU team organized and moderated presentation sessions at TRB Annual Meeting devoted to flashing traffic control devices for pedestrians

1.4 How have the results been disseminated?

- TRCLC news and information have been disseminated through e-mails, website, and Facebook.
- Bicycling Sharing System data disseminated via ArcGIS web service
- Released Lake Michigan Water Trail App on Android Store

1.5 What do you plan to do during the next period to accomplish the goals and objectives?

Research

- The TRCLC plans to release request for proposals research projects to start from May 2016. Thirteen proposals were recommended for funding by Research Advisory Committee.
- Plan to develop a regular forum among researchers in similar interests in order to develop state-of-the-art research topics and discuss research direction.
- Monitor research progress via monthly research meeting with project investigators
- Compile data used by individual research projects and put them in the database to share among researchers
- Develop safety performance functions that can be used to evaluate the safety impacts of various access management practices to pedestrians

Education and Workforce Development

- TRCLC will host an awarding ceremony for the first livable community mobile app development competition in May 2015 to encourage high school students to understand importance of transportation issues in the context of livable communities
- Plan to host a training session to prepare students to take the American Concrete Institute (ACI) – Field Technician Grade I Certification
- Continue to provide invited speaker series
- USU Continues with ITE seminar series by inviting speakers from public and private sectors to share their knowledge and experience with transportation students

Technology Transfer

- Plan to develop web-based research clearinghouse to provide technical information to the agencies
- Host the third TRCLC summer conference in June 2016.
- Plan to organize meetings with Kalamazoo and Portage City engineers and planners to educate them about the research being conducted as well as to understand their needs
- Newsletters will be published and disseminated to the center affiliated agencies.

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- Build a list of statewide stakeholders related with pedestrian and bicycle safety research and practices and identify research needs via a survey.
 - Technical information will be disseminated through the TRCLC website (www.wmich.edu/transportationcenter) and the TRCLC Facebook (<https://www.facebook.com/TRCLC>).
 - USU will develop a Facebook site to provide information on on-going projects to interested stakeholders, and continue to provide news and information through the Utah Transportation Center website (<http://transportation.usu.edu>).

Collaboration

- TRCLC will continue developing a community research problem depository system for communities to submit their research problems as a way of strengthening collaborations with local communities.
- TRCLC will build a collaboration network with other UTCs for the second summer conference on livable communities.
- TRCLC will collaborate with the WMU Office of Sustainability to expand its research scope
- Extend international collaboration with Tongji University and Fuzhou University in China, and Hanyang University in Korea
- Collaborate with DuPage Mayors and Managers Conference (DMMC) to develop series of non-motorized transportation planning guidance documents for councils of governments (COGs)
- Continue collaboration among researches from Western Michigan University (WMU), Tennessee State University (TSU), and Wayne State University (WSU) on pedestrian and bicycle safety

Diversity

- Plan to invite more researchers in other disciplines
- Recruit more women and African American research staff and graduate students
- Provide opportunities to students from underrepresented groups and low income communities

2. PRODUCTS

2.1 Publications, conference papers, and presentations

Publications

- 1) [WMU] Angel, M.L., Sando, T., Chimba, D., and Kwigizile, V. Effects of Rain on Traffic Operations on Florida Freeways. *Transportation Research Record*, Volume 2440, Transportation Research Board, 2015, pp. 51-59.

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- 2) [WMU] Kwigizile, V., Sando, T. and Chimba, D (2014). Understanding the Role of Alcohol and Drugs on Bicyclist Injury Severity. *Advances in Transportation Studies-An International Journal*. Volume 34, Section A, pp. 43-54.
 - 3) [WMU] Clark, M., Oh, J., Kwigizile, V, and Castle, C. (2015). Perception of Advanced Traveler Information by Active Users. (in press) *Transportation Research Record, Transportation Research Board*
 - 4) [WMU] Attanayake, U. B., & Aktan, H. The First Generation ABC System, Evolving Design, and Half a Century Performance– Michigan Side-by-Side Box-Beam Bridge, *ASCE Journal of Performance of Constructed Facilities*, Vol. 29, No. 3.
 - 5) [WMU] Sun, Z., Hao, P., Ban, X., & Yang, D. (2014). Trajectory-based vehicle energy/emissions estimation for signalized arterials using mobile sensing data. *Transportation Research, Part D*, 34, 27-40.
 - 6) [WMU] Yang, X., Sun, Z., Ban, X., & Holguin-Veras, J. (2014). Urban freight delivery stop identification using GPS data. *Transportation Research Record*, 2411, 55-61.
 - 7) [WMU] Cho, H. and Qu, A. (2015). Efficient estimation for longitudinal data by combining large-dimensional moment conditions, *Electronic Journal of Statistics* 9, 1315-1334.
 - 8) [WMU] Park, J., Lawrence, C. B. and Cho, H. (2015). A discursive assessment of narrative journalism using coh-matrix and principal component analysis, *Journal of the 21st Century Association of English Language and Literature* 28, 383-400.
 - 9) [WMU] Bourquin, G., Wall Emerson, R., Barlow, J., & Sauerburger, D. (2015). Conditions that influence drivers' behavior at a roundabout: Increasing yielding. *Journal of Visual Impairment & Blindness*, 109.
 - 10) [WMU] Bourquin, G., Wall Emerson, R., Barlow, J., & Sauerburger, D. (2015). Conditions that influence drivers' yielding behavior: Effect of pedestrian eye gaze and head movements. *Journal of Visual Impairment & Blindness*, 109.
 - 11) [WMU] Kim, D. S., Wall Emerson, R. S., & Gaves, E. (2015). Travel in adverse weather conditions by blind pedestrians: Effect of cane tip design on travel in snow. *Journal of Visual Impairment & Blindness*, 109.
 - 12) [WMU] Wall Emerson, R. Kim, D., Naghshineh, K., & Myers, K. (2015). Effect of artificial alert sound, background noise, and vehicle type on detectability and localizability of quiet cars by blind pedestrians. *ITE Journal*.
 - 13) [WMU] Kim, D., Wall Emerson, R. Naghshineh, K., & Myers, K. (2014). Influence of ambient sound fluctuations on the crossing decisions of pedestrians who are blind: Implications for setting minimum sound level for quiet vehicles. *Journal of Visual Impairment & Blindness*, 108, 368-383.
 - 14) [WMU] Kim, D. S., & Wall Emerson, R., (2014). Effect of cane technique on obstacle detection performance. *Journal of Visual Impairment & Blindness*, 108, 335-340.
 - 15) [WMU] Wall-Emerson, R. Kim, D., Naghshineh, K., and Myers, K. (2015). Effect of artificial alert sound, background noise, and vehicle type on detectability and localizability of quiet cars by blind pedestrians. *ITE Journal*.

-
- 16)[WMU] Kim, D., Wall Emerson, R. Naghshineh, K., and Myers, K. (2014). Influence of ambient sound fluctuations on the crossing decisions of pedestrians who are blind: Implications for setting minimum sound level for quiet vehicles. *Journal of Visual Impairment & Blindness*, 108, 368-383.
 - 17)[WMU] Kim, D., & Wall Emerson, R. (2014). Effect of cane technique on obstacle detection with the long cane. *Journal of Visual Impairment & Blindness*, 108, 335-340.
 - 18)[WMU] Van Houten, R., DeLaere, G. Shurbutt, J., & Morgan, J.F. (in press). Countdown Pedestrian Signals Legibility and Comprehension without Flashing Hand. *Transportation Research Record*.
 - 19)[WMU] DeLaere, G., Van Houten, R. & Shurbutt, J. (in press). Countdown Pedestrian Signals and Low Vision Pedestrians. *Transportation Research Record*.
 - 20)[WMU] Fees, C.A., Torbic, D.J., Van Houten, R., Bauer, K.M., Roseberry, N., & LaPlante, J. (in press). Design Guidance for Bicycle Lane Widths. *Transportation Research Record*.
 - 21)[WMU] Huitema, B., Van Houten, R. & Manel H. (2014). Time-Series Intervention Analysis of Pedestrian Countdown Timer Effects. *Accident Analysis and Prevention*. 72, 23-31.
 - 22)[WMU] Bennett, M. & Van Houten, R. (2014). A Comparison of Gateway In-Street Sign Treatment to other Driver Prompts to Increase Yielding to Pedestrians at Crosswalks *Journal of Applied Behavior Analysis*. 47, 1-13.
 - 23)[WMU] Van Houten, R., Reagan, I.J., & Hilton. B. (2014). Increasing Seat Belt Use: Two Field Experiments to Test Engineering-based Behavioral Interventions. *Transportation Research Part F: Traffic Psychology and Behaviour*, 23, 133-146.
 - 24) [USU] Kitthamkesorn, S., Chen, A., Xu, X. (2015) Elastic demand with weibit stochastic user equilibrium flows and application in a motorized and non-motorized network. *Transportmetrica A: Transport Science* 11(2), 158-185. Doi: 10.1080/23249935.2014.944241.
 - 25)[USU] Li., L., Xiong, J., Chen, A., Dong, Z., Zhao, S. (2015) Study of key strategies for public transportation improvement based on theory of planned behavior: A case study in Shanghai, China. *ASCE Urban Planning and Development* 141(2), 04014019. DOI: 10.1061/(ASCE)UP.1943-5444.0000203
 - 26)[USU] Pu, Y., Yang, C., Liu, H., Chen, Z., Chen, A. (2015) Impact of license plate restriction policy on emission reduction in Hangzhou using a bottom-up approach. *Transportation Research Part D* 34, 281-292. DOI: 10.1016/j.trd.2014.11.007.
 - 27)[USU] Xu, X., Chen, A., Cheng, L. (2015) Reformulating environmentally constrained traffic equilibrium via a smooth gap function. *International Journal of Sustainable Transportation* 9(6), 419-430. Special issue on "Sustainability in Transport Networks." DOI:10.1080/15568318.2013.777261.
 - 28)[USU] Xu, X., Chen, A., Wong, S.C., Cheng, L. (2015) Short communication: Selection bias in build-operate-transfer transportation project appraisal. *Transportation Research Part A* 75, 245-251. Doi:10.1016/j.tra.2015.03.026
 - 29)[USU] Yang, X., Chen, A., Li, X., Ning, B., Tang, T. (2015) An energy-efficient scheduling approach to improve the utilization of regenerative energy for metro

-
- rail systems. *Transportation Research Part C* 57, 13-29. DOI: 10.1016/j.trc.2015.05.002
- 30)[USU] Chen, Z., Yang, C., Chen, A. (2014) Estimating fuel consumption and emissions based on reconstructed vehicle trajectories. *Journal of Advanced Transportation* 48(6), 627-641. Doi: 10.1002/atr.1215
- 31)[USU] Ryu, S., Chen, A., Xu, X., Choi, K. (2014) Modeling demand elasticity and route overlapping in stochastic user equilibrium through paired combinatorial logit model. *Transportation Research Record* 2429, 8-19. DOI: 10.3131/2429-02.
- 32)[USU] Ryu, S., Chen, A., Zhang, H.M., Recker, W. (2014) Path flow estimator for planning applications of small communities. *Transportation Research Part A* 69, 212-242. Doi: 10.1016/j.tra.2014.08.019.
- 33)[USU] Zhu, S., Cheng, L., Chu, Z., Chen, A., Chen, J. (2014) Identification of network sensor locations for traffic flow estimation. *Transportation Research Record* 2443(2), 32-39. DOI: 10.3141/2443-04.
- 34)[USU] Song, Z., Yin, Y., Lawphongpanich, S. (2015). Optimal deployment of managed lanes in general networks. *International Journal of Sustainable Transportation* 9(6), 431-441.
- 35)[USU] Khalilikhah, M., Heaslip, K., Song, Z. (2015) Can daytime digital imaging be used for traffic sign retroreflectivity compliance? *Measurement* 75, 147-160. DOI: doi:10.1016/j.measurement.2015.07.049.
- 36)[USU] Li, L., Wang, J. Song, Z., Dong, Z., Wu, B. (2015) Analyzing the impact of weather on bus ridership using smart card data. *IET Intelligent Transport Systems* 9(2), 221-229. DOI: 10.1049/iet-its.2014.0062.
- 37)[USU] Sharifi, M.S., Stuart, D., Christensen, K.M., Chen, A., Kim, Y.S., Chen, Y. (2015) Analysis of walking speeds involving individuals with disabilities in different indoor walking environments. *Journal of Urban Planning and Development (online ahead of print)* DOI: 10.1061/(ASCE)UP.1943-5444.0000288.
- 38)[USU] Sharifi, M.S., Stuart, D., Christensen, K.M., Chen, A. (in press) Traffic flow characteristics of heterogeneous pedestrian stream involving individuals with disabilities. *Transportation Research Record*
- 39)[WSU] Savolainen, P. Sharma, A., Gates, T. Driver Decision-Making in the Dilemma Zone - Examining the Influences of Clearance Intervals, Enforcement Cameras and the Provision of Advance Warning through a Panel Data Random Parameters Probit Model. *Accident Analysis and Prevention*. 2015, In Press.
- 40)[WSU] Gates, T.J. and D.A. Noyce. A Process for Dynamic Extension of the Red Clearance Interval as a Countermeasure for Dilemma Zone Red-Light-Running. *Accident Analysis & Prevention* 2015, In Press.
- 41)[WSU] Davis, A. E. Hacker, P.T. Savolainen, and T.J. Gates. A Longitudinal Analysis of Rural Interstate Fatalities in Relation to Speed Limit Policies. *Transportation Research Record*, 2015, In Press.
- 42)[WSU] Davis, A. E. Hacker, P.T. Savolainen, and T.J. Gates. A Longitudinal Analysis of Rural Interstate Fatalities in Relation to Speed Limit Policies. *Transportation Research Record: Journal of the Transportation Research Board*, 2015, In Press.

-
- 43)[WSU] Kay, J.J., P.T. Savolainen, T.J. Gates, T.K. Datta, J. Finkelman, and B. Hamadeh. Safety Impacts of Michigan's Statewide Centerline Rumble Strip Program. Transportation Research Record: Journal of the Transportation Research Board, 2015, In Press.
 - 44)[WSU] Savolainen P.T., A. Sharma, and T.J. Gates. Driver Decision-Making in the Dilemma Zone - Examining the Influences of Clearance Intervals, Enforcement Cameras and the Provision of Advance Warning through a Random Effects Probit Model. Accident Analysis & Prevention 2015, In Press.
 - 45)[WSU] Russo, B.J., E. Rista, P.T. Savolainen, T.J. Gates, and S. Frazier. Analysis of Vehicle Speed Characteristics among States with Uniform and Differential Speed Limit Policies. Transportation Research Record: Journal of the Transportation Research Board, 2015, In Press.
 - 46)[WSU] Ghosh, I., Savolainen, P.T., and T.J. Gates. Examination of Factors Affecting Freeway Incident Clearance Times: A Comparison of the Generalized F Model and Several Alternative Nested Models. Journal of Advanced Transportation, 2014.
 - 47)[WSU] Gates, T.J., P.T. Savolainen, and H.U. Maria. Prediction of Driver Action at Signalized Intersections using a Nested Logit Model. In Transportation Research Record 2463: Journal of the Transportation Research Board, TRB, Washington, D.C., 2014.
 - 48)[WSU] Gates, T.J., P.T. Savolainen, A. McArthur, P. Andridge, T. Kirsch, S.P. McElmurry, Assessing Suitability of Nontraditional Development in Roadside Right-of-Way, Transportation Research Record, Transportation Research Record 2436: Journal of the Transportation Research Board, TRB, Washington, D.C., 2014.
 - 49)[WSU] Kay, J.J., P.T. Savolainen, T.J. Gates, and T.K. Datta. Driver Behavior during Bicycle Passing Maneuvers in Response to a Share the Road Sign Treatment, Accident Analysis and Prevention, Vol. 70, Sept 2014, pp. 92-99.
 - 50)[WSU] Kay, J.J., T.J. Gates, P.T. Savolainen, A. McArthur, and B.J. Russo, Empirical Models of Demand Levels and Turn-in Rates at Roadside Rest Areas, In Transportation Research Record 2430: Journal of the Transportation Research Board, TRB, Washington, D.C., 2014.
 - 51)[WSU] McArthur, A., P.T. Savolainen, and T.J. Gates, Spatial Analysis of Child Pedestrian and Bicycle Crashes: Development of a Safety Performance Function for Areas Adjacent to Schools, In Transportation Research Record 2465: Journal of the Transportation Research Board, TRB, Washington, D.C., 2014.
 - 52)[WSU] Barrette, T.P., T. Kirsch, P.T. Savolainen, B.J. Russo, and T.J. Gates, Disaggregate-level Assessment of Changes to Michigan's Motorcycle Helmet Use Law, In Transportation Research Record 2468: Journal of the Transportation Research Board, TRB, Washington, D.C., 2014.
 - 53)[TSU] Musinguzi A and Chimba D. "Using Kernel Density to Evaluate Dependence of Pedestrian Crashes on Demographic and Socioeconomic factors". *submitted to Journal of Case Studies on Transport Policy*.

Conference Papers

- 1) [WMU] Dolatsara, H. A., Oh, J. and Kwigizile, V. (2015). Influential Range for Analyzing Motorized and Non-motorized Crashes at Intersections. Presented at the *94th Annual Meeting of the Transportation Research Board (TRB)*, January 2015, Washington, D.C.
- 2) [WMU] Clark, M., Oh, J., Kwigizile, V, and Castle, C. (2015). Perception of Advanced Traveler Information by Active Users. Presented at the *94th Annual Meeting of the Transportation Research Board (TRB)*, January 2015, Washington, D.C.
- 3) [WMU] Fink, J., Kwigizile, V, and Oh, J. (2015). Impact of Adaptive Traffic Control Systems on Crash Frequency and Severity. Presented at the *94th Annual Meeting of the Transportation Research Board (TRB)*, January 2015, Washington, D.C.
- 4) [WMU] Attanayake, U. "Application of Hot Spot Modeling and Analysis Guidelines for a Web Gap Detail," the 8th New York City Bridge Conference, New York City, New York, August 24-25, 2015.
- 5) [WMU] Lopez, L. and Attanayake, U. "Developing a methodology for evaluating non-motorized access alternatives over existing highway bridges," the 8th New York City Bridge Conference, New York City, New York, August 24-25, 2015.
- 6) [WMU] Wall Emerson, R. S. "Use of sound in navigation for people who are blind," invited presentation at Smith-Kettlewell Eye Research Institute, San Francisco, CA, February, 2015.
- 7) [WMU] Kim, D. and Wall Emerson, R. (2015, July). *Travel in adverse winter weather conditions by blind pedestrians: Effect of cane tip design on travel on snow*. TRCLC 2nd Annual Summer Conference, Kalamazoo, MI.
- 8) [WMU] Gaves, E. (2015, April). *Effects of cane tip on winter travel for blind pedestrians*. Lee Honors College Thesis Presentation, Kalamazoo, MI.
- 9) [WMU] Sun, Z., Hao, P., & Ban, X. "Fine-grained modeling of arterial traffic: a data fusion and information integration approach," *Proceedings of the 94th Annual Meeting of Transportation Research Board*, Washington, DC, January, 2015.
- 10) [WMU] Sun, Z., & Ban, X. "Identifying multiclass vehicles using GPS data," *Proceedings of the 94th Annual Meeting of Transportation Research Board*, Washington, DC, January, 2015.
- 11) [WMU] Lemberg, D., "Coastal Access for Sea Kayaks – Issues of Location and Conflict Resolution," Annual Meeting of the Association of American Geographers 2015, Chicago, IL, April 20-25, 2015.
- 12) [WMU] B. Schmidt, D. Kountanis, A. Al-Fuqaha, "A Biologically-Inspired Approach to Network Traffic Classification for Resource-Constrained Systems," International Symposium on Big Data Computing (BDC 2014), London, UK, 8-11 December 2014.
- 13) [WMU] B. Schmidt, D. Kountanis, A. Al-Fuqaha, "Artificial Immune System Inspired Algorithm for Flow-Based Internet Traffic Classification," IEEE CloudCom 2014, Big Data Track, Singapore, 15-18 December 2014.
- 14) [WMU] M. A. Salahuddin, A. Al-Fuqaha, M. Guizani, S. Cherkaoui, "RSU Cloud and its Resource Management in support of Enhanced Vehicular Applications,"

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- IEEE Globecom Workshop on Cloud Computing Systems, Networks and Applications (CCSNA 2014), Austin, Texas, 8-12 December 2014.
- 15)[WMU] Explorations into the Equity Dimensions of US Bicycle Sharing Systems. Poster presented at the Association of American Geographers Annual Meeting, April 21-24, 2015. Chicago, IL
 - 16)[WMU] Lemberg, D., "Coastal Access for Sea Kayaks - Issues of Location and Conflict Resolution" 2015 Annual Meeting of the Association of American Geographers, Chicago, IL, April, 2015
 - 17)[WMU] Lemberg, D. "A Cellphone App for Collecting Travel Data: An Alternative to the Travel Diary", 2014 AAG East Lakes – West Lakes Conference, Kalamazoo, MI, October, 2014
 - 18)[WMU] Lei, Cheyenne, C. Scott Smith and Jun Seok Oh. Explorations into the Equity Dimensions of US Bicycle Sharing Systems poster presented at the 2015 Association of American Geographers Annual Meeting. Chicago, IL April 21-April 25.
 - 19)[WMU] Smith, C. Scott, Cheyenne Lei, and Jun Seok Oh. Confronting Equity in the Design of Bicycle Sharing Systems presented at 2015 Transport Chicago Conference. Chicago, IL June 12.
 - 20)[WMU] Smith, C. Scott, Cheyenne Lei, and Jun Seok Oh. Confronting Equity in Bike-Sharing Systems presented at 2nd Summer Conference on Livable Communities. Kalamazoo, MI July 23-July 25 2015
 - 21)[WMU] Hasan, Mehedi and C. Scott Smith. An Accessibility and Equity Analysis of Chicago's Public Bike-Share System, Illinois to be presented at the East Lakes Division of the Association of American Geographers Conference. Kent, OH October 9-10 2015.
 - 22)[USU] Kang, J.E., Chen, A. "Constructing full-day feasible space-time polyhedron using activity-based space-time prisms," the 94th *Transportation Research Board Annual Meeting*, Washington D.C., USA, Jan. 11-15, 2015.
 - 23)[USU] Ryu, S., Chen, A., Choi, K. "**A two-stage bicycle traffic assignment model**," the 94th *Transportation Research Board Annual Meeting*, Washington D.C., USA, Jan. 11-15, 2015.
 - 24)[USU] Ryu, S., Chen, A., Choi, K. "**Solving the stochastic multiclass traffic assignment problem with asymmetric interactions and vehicle restrictions**," the 94th *Transportation Research Board Annual Meeting*, Washington D.C., USA, Jan. 11-15, 2015.
 - 25)[USU] Sharifi, M.S., Stuart, D., Christensen, K., Chen, A. "Exploring traffic flow characteristics and walking speeds of heterogeneous pedestrian stream involving individuals with disabilities in different walking environments," the 94th *Transportation Research Board Annual Meeting*, Washington D.C., USA, Jan. 11-15, 2015.
 - 26)[USU] Sharifi, M.S., Chen, A., Kitthamkesorn, S., Song, Z. "Link-based stochastic loading methods for the weibit route choice model," the 94th *Transportation Research Board Annual Meeting*, Washington D.C., USA, Jan. 11-15, 2015.

-
- 27)[USU] Chen, A. "A bicycle network analysis tool for planning applications," the 5th COTA International Conference of Transportation Professionals (CICTP 2015), Beijing, China, July 25-27, 2015.
 - 28)[USU] Kang, J.E., Chen, A. "Constructing full-day feasible space-time polyhedron using activity-based space-time prisms," the 6th International Symposium on Transportation Network Reliability (INSTR 2015), Nara, Japan, Aug. 2-3, 2015.
 - 29)[USU] Shao, H., Lam, W.H.K, Sumalee, A., Chen, A. "Network-wide on-line travel time estimation with inconsistent data from multiple sensor systems under network uncertainty," the 6th International Symposium on Transportation Network Reliability (INSTR 2015), Nara, Japan, Aug. 2-3, 2015.
 - 30)[USU] Vanitchakornpong, K., Zhou, Z., Chen, A., Indra-Payoong, N., Jansuwan, S. "A time-dependent alpha-reliable mean-excess path finding model in stochastic networks," the 6th International Symposium on Transportation Network Reliability (INSTR 2015), Nara, Japan, Aug. 2-3, 2015.
 - 31)[USU] Xu, X., Chen, A., Cheng, L., Yang, C. "A link-based mean-excess traffic equilibrium model under uncertainty," the 6th International Symposium on Transportation Network Reliability (INSTR 2015), Nara, Japan, Aug. 2-3, 2015.
 - 32)[USU] Xu, X., Chen, A., Kitthamkesorn, S., Yang, H., Lo, H.K. "Modeling absolute and relative cost differences in stochastic user equilibrium problem," the 21st International Symposium on Transportation and Traffic Theory (ISTTT21), Kobe, Japan, Aug. 5-7, 2015.
 - 33)[USU] Xu, X., Chen, A., Jansuwan, S., Heaslip, K, Yang, C. "Modeling transportation network redundancy," the 21st International Symposium on Transportation and Traffic Theory (ISTTT21), Kobe, Japan, Aug. 5-7, 2015.
 - 34)[USU] Chen, A. "A decision support system tool for assessing vulnerability of transportation networks," the 8th ATRANS Symposium on Transportation for a Better Life: Harnessing Finance for Safety and Equity in AEC, Bangkok, Thailand, August 21, 2015.
 - 35)[USU] Kitthamkesorn, S., Chen, A., Xu, X., Ryu, S., Yang, C. "Combined model with go-green modes," the 2nd Thailand Rail Academic Symposium (TRAS-2), Phitsanulok, Thailand, August 26-28, 2015.
 - 36)[USU] Stuart, D., Sharifi, M.S., Christensen, K.M., Chen, A., Kim, Y.S., Chen, Y. "Modeling different groups of pedestrians with physical disability using the social force model and fractional order potential fields," the ASME 2015 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, IDETC/CIE 2015, Boston, Massachusetts, USA, Aug. 2-5, 2015.
 - 37)[WSU] Rista, E., Barrette, T., Hamazeie, R., Savolainen, P, Gates, T. Work Zone Safety Performance: A Comparison of Alternative Traffic Control Strategies. 2015 Road Safety and Simulation Conference (RSS), Orlando, Florida, 2015.
 - 38)[WSU] Holzem, A.M., Hummer, J.E., Cunningham, C.M., O'Brien, S.W., Schroeder, B.J., and Salamati K. "Pedestrian And Bicyclist Accommodations And Crossings On Superstreet", 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.

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- 39)[WSU] Pankok, C., Kaber, D.B., Rasdorf, W.J, and Hummer J.E., “Driver Attention and Performance Effects of Guide and Logo Signs Under Freeway Driving”, North
 - 40)[WSU] Vaughan C.L., Jagadish, C., Bharadwaj, S.S., Cunningham, C.M., Schroeder, B.J., Hummer, J.E., Findley, D.J., and Roupail, N.M., “Long-Term Monitoring of Wrong-Way Maneuvers at Diverging Diamond Interchanges”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 41)[WSU] Kay, J.J., Savolainen, P.T., Gates, T.J., Datta, T.K., Finkelman, J. and Hamadeh, B. “Safety Impacts of Michigan’s Statewide Centerline Rumble Strip Program”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 42)[WSU] Gates, T.J. and Savolainen, P.T., “Economic Analysis of Speed Limit Policy Impacts”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 43)[WSU] Russo, B.J., Rista, E., Savolainen, P.T., Gates, T.J., and Frazier. S. “Analysis of Vehicle Speed Characteristics among States with Uniform and Differential Speed Limit Policies”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 44)[WSU] Savolainen, P.T., and Gates T.J.. “Freeway Crash Trends in Relation to Posted Speed Limits: Contrasts Between Cross-Sectional and Before-and-After Evaluations”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 45)[WSU] Morden, J., Russo, B.J., Savolainen, P.T., and Gates T.J. “Examination of Factors Associated with Motorcycle Helmet Use after Transition from Universal to Partial Helmet Law”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 46)[WSU] Russo, B.J., Savolainen, P.T., Gates, T.J., and Kirsch T.. “Evaluating Safety Impacts of High-Tension Cable Median Barrier Installation Program”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 47)[WSU] Davis, A. Hacker, E. Savolainen, P.T., and Gates T.J., “A Longitudinal Analysis of Rural Interstate Fatalities in Relation to Speed Limit Policies”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 48)[WSU] Hamadeh, B., Savolainen, P.T., “Seat Belt Use by Commercial Motor Vehicle Occupants in Relation to Driver, Vehicle, and Location-Specific Factors”, 94th Annual Meeting of the Transportation Research Board, Washington, D.C., 2015.
 - 49)[WSU] Chandra, S. M. Mohan, and T.J. Gates. “Estimation of Critical Gap using Intersection Occupancy Time Data”. Proceedings from the 19th International Conference of Hong Kong Society for Transportation Studies, Hong Kong Polytechnic University, 2014.
 - 50)[TSU] Musinguzi A and Chimba D.. “Using Spatial Statistical Tools to correlate Bicycle and Pedestrian Crashes with Socio- demographics” . Presented at “TSU 37th Annual University-Wide Research Symposium, 2015; 4/2/2015”
 - 51)[TSU] Musinguzi A and Chimba D. “Bayesian Logistic Regression Analysis of Socioeconomic and Demographic Factors and Pedestrian Crash Counts”.

Accepted for presentation at “2015 Southern District ITE Annual Meeting, MS, April 19-22, 2015”

52)[TSU] Musinguzi, A and Chimba, D.. “Using Spatial Statistical Tools to correlate Bicycle and Pedestrian Crashes with Socio- demographics”. Presented at “TSU 37th Annual University-Wide Research Symposium, 2015; 4/2/2015”

53)[TSU] Musinguzi, A and Chimba, D. “Bayesian logistic regression analysis of socioeconomic and demographic factors and pedestrian crash counts”. Presented at “2015 Southern District ITE Annual Meeting, MS, April 19-22, 2015”

54)[TSU] Musinguzi, A and Chimba, D. “Spatial Variation in Local Road Pedestrian and Bicycle Crashes”. Presented at “2015 Esri User Conference, San Diego, CA, 7/21/2015”

55)[TSU] Kidando, E, Musinguzi, A and Chimba, D. “Bayesian hierarchical analysis of pedestrian crashes and socio-demographic factors” Presented at the 2nd Summer Conference on Livable Communities, Kalamazoo, MI, 7/23/2015.

2.2 Website or other Internet sites

- TRCLC disseminates information and relevant news via TRCLC website and the TRCLC Facebook page
 - Website – www.wmich.edu/transportationcenter
 - Facebook – www.facebook.com/TRCLC
- Lake Michigan Water Trail Website – Michigan Section (www.lmwt.org)

2.3 Technologies and techniques

- Nationwide bicycle sharing system station locations, characteristics and associated socio-economic data to be shared on website
- During project performance period, shared hardware and software developed by Blindness and Low Vision Studies (BLS) and Electrical Engineering and Computer Engineering (ECE) to assist training blind pedestrians to walk straighter paths in crosswalks and other open areas with University of California, Santa Cruz engineering faculty who are considering incorporating the technology into a smartphone app.
- Released Lake Michigan Water Trail App on Android Store

2.4 Inventions, patent applications, and/or licenses

- Nothing to report.

2.5 Other products

- Nothing to report.

3. PARTICIPANT & COLLABORATING ORGANIZATIONS

3.1 What organizations have been involved as partners?

Organization Name	Type / Location	Partner's contribution				
		Financial support	In-kind support	Facilities/ Data	Collaborative research	Personnel exchanges
Michigan State Police	Government / MI	X		X		
Kalamazoo Township	Government / MI				X	
City of Kalamazoo	Government / MI		X	X	X	
City of Portage	Government / MI		X	X		X
City of Paw Paw	Government / MI		X			
City of Gainesville	Government / FL		X		X	X
City of Three Rivers	Government / MI					X
City of Grand Rapids	Government / MI			X		
City of Detroit	Government / MI			X		X
OPUS	Private / MI				X	
URS	Private / MI				X	
Nokia	Private Chicago/ IL		X	X		X
Traumasoft	Private / MI	X			X	
Accessible Design for the Blind	Private/NC				X	X
Helen Keller Institute					X	X
Disability Network Southwest Michigan	Agency / MI				X	X
Kalamazoo Area Transportation Study	MPO / MI		X	X	X	X
Kalamazoo Metro Transit	Transit Agency / MI			X	X	
South East Michigan Council of Governments	MPO / MI		X	X		
Western Michigan University	University / MI	X	X	X		
University of Texas- Arlington	University / TX	X	X	X		
Utah State University	University / UT	X	X	X		

Organization Name	Type / Location	Partner's contribution				
		Financial support	In-kind support	Facilities/ Data	Collaborative research	Personnel exchanges
Wayne State University	University / MI	X	X	X		
Tennessee State University	University / TN	X	X	X		
University of Florida	University / FL		X		X	X
Purdue University	University / IN				X	X
City Univ. of New York	University / NY				X	X
Univ. of Nebraska Lincoln	University / NE				X	X
Ajou University, Suwon, Korea	University / Korea				X	
Michigan DOT	Government / MI	X		X	X	X
Utah DOT	Government / UT	X	X	X		
Tennessee DOT	Government / TN			X		
Rocky Mountain ADA Center	National ADA Center / Colorado				X	
Williamson County	Government / TN			X		

- List of Research Projects from Other Partners
 - [WMU] "Comparison of Pedestrian Crosswalk Treatments," Michigan Department of Transportation, October 2013 – June 2015, \$218,513, Ron Van Houten
 - [WMU] "Costs and Benefits of Michigan ITS Deployments," Michigan Department of Transportation, June 2013 – March 2014, \$233,395, Jun-Seok Oh, Valerian Kwigizile
 - [WMU] "Enforcement Data Analysis for Overtime Traffic Enforcement", Michigan Office of Highway Safety Planning (OHSP), \$73,496, October 2013 - September 2014, Valerian Kwigizile, Jun-Seok Oh
 - [WMU] "Evaluation of Michigan's Engineering Improvements for Older Drivers", Michigan Department of Transportation (MDOT), \$295,582, October 2013 – September 2015. Valerian Kwigizile, Jun-Seok Oh, Ron Van Houten
 - [WMU] "Evaluating Michigan Commercial Vehicle Enforcement Strategies and Facilities", Michigan Department of Transportation (MDOT), \$268,560.45, April 2013 – March 2015
 - [WMU] Reflective Cracking between Precast Prestressed Box Girders, Wisconsin Highway Research Program- Wisconsin DOT, August 1, 2013 – July 31, 2015, \$85,000, Upul Attanayake, Haluk Aktan

- [WMU] Remote Monitoring of Fatigue Sensitive Details on Bridges, Michigan DOT, October 1, 2012 – September 30, 2014, \$250,000, Upul Attanayake, Haluk Aktan
- [WMU] Research on Evaluation and Standardization of Accelerated Bridge Construction (ABC) Techniques, Michigan DOT, October 2013- December 2015, \$250,000, Haluk Aktan, Upul Attanayake
- [WMU] “REACCT: Real-Time Emergency Action Command Center Tool (Mesh Networking and Localization for Emergency Response Teams),” Traumasoft Corp., April 2014-Dec. 2014, \$27,593, Ala Al-Fuqaha
- [WMU] “Next Gen. Information for Pilot: Low Cost Mobile Training Solutions,” Western Michigan University, Technology Development Award, Feb. 2014-Aug. 2015, \$18,531, Lori Brown, Ala Al-Fuqaha
- [WMU] “Better long cane design and biomechanics for blind cane users,” funded by National Institutes of Health, Feb 1, 2014 – Jan 31, 2017, \$421,125, Dae Shik Kim, Robert Wall Emerson, Koorosh Naghshineh
- [WMU] “On Countdown Pedestrian Signals Legibility and Comprehension without Flashing Hand Battelle Corporation, August 2013 – June 2015, \$131,731, Ron Van Houten
- [WMU] QNRF NPRP, “Engineering Security and Performance Aware Vehicular Applications for Safer and Smarter Roads,” Project PI with Elyes BenHamida (QMIC, Lead-PI) and Bharat Bhargava (Purdue University, PI), 2014. (Amount: \$900,000) – Ala Al-Fuqaha
- [WMU] National Science Foundation (EARS program), “Collaborative Research: Applying Behavioral-Ecological Network Models to Enhance Distributed Spectrum Access in Cognitive Radio,” Project Co-PI with Bilal Khan (City University of New York, PI) and Kirk Dombrowski (University of Nebraska Lincoln, Co-PI), 2014. (Amount: \$499,986) – Ala Al-Fuqaha
- [WMU] 2014 NHTSA The Effects of High Visibility enforcement on Driver Compliance to Pedestrian Yield Right of Way Laws Follow-up (\$ 73,759) – Ron Van Houten
- [WMU] 2013 DOT Subcontract from Battelle On Countdown Pedestrian Signals Legibility and Comprehension without Flashing Hand (\$ 131,731) – Ron Van Houten
- [WMU] 2013 Contract MDOT Comparison of Pedestrian Crosswalk Treatments (\$ 218,513) – Ron Van Houten.
- [UTA] *Oregon Heavy Vehicle (HV) Seasonal and Growth Factors*, September 2014 –June 2015, \$27,395, ODOT
- [USU] “Experimental Research on Pedestrian and Evacuation Behaviors of Individuals with Disabilities; Theory Development Necessary to Characterize Individual-Based Models”, The National Institute on Disability and Rehabilitation Research (NIDRR); Field Initiated Projects, \$594,486, October 2011-March 2015.
- [USU] “Development of Network-Based Measures and Computational Methods for Evaluating the Redundancy of Transportation Networks”, Mountain Plains Consortium – A Federally Funded Regional Transportation Center, \$50,000, July 2014 – Dec. 2015.

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- [USU] “Implementation of Aerial LiDAR Technology to Update Highway Feature Inventory”, Mountain Plains Consortium – A Federally Funded Regional Transportation Center and Utah Department of Transportation (UDOT), \$150,000, July 2014 – Dec. 2015.
 - [USU] “Rehabilitation Project Selection and Scheduling in Transportation Networks”, Mountain Plains Consortium – A Federally Funded Regional Transportation Center, \$30,000, July 2014 – Dec. 2015.
 - [USU] “A Comprehensive Safety Assessment Methodology for Innovative Geometric Designs”, Utah Department of Transportation (UDOT), \$40,000, 2015 -2016.
 - [USU] “Modeling multi-class truck traffic assignment method with different traffic restraint constraints”, Mountain Plains Consortium – A Federally Funded Regional Transportation Center and Utah Department of Transportation (UDOT), \$80,000, July 2015 – Dec. 2016.
 - [USU] “A comprehensive safety assessment methodology for innovative geometric designs”, Mountain Plains Consortium – A Federally Funded Regional Transportation Center, \$40,000, July 2015 – Dec. 2016.
 - [USU] “Analysis of walking facility performance guidelines for individuals with disabilities”, Utah Agricultural Experiment Station (UAES) Seed Grants Program, Utah State University, \$12,637, July 2015 – June 2016.
 - [WSU] Engineering Support for Michigan Safe Routes to School Programs, Michigan Fitness Foundation (through Michigan DOT), October 1, 2013 – September 30, 2014, \$75,000. Tim Gates
 - [TSU] Guidance for Site Selection, Safety Effectiveness Evaluation, and Crash Modification Factors of Median Cable Barriers in Tennessee. Funded by the Tennessee Department of Transportation (TDOT), August 01, 2013 to July 31, 2018. Amount \$105,000., Deo Chimba
 - [TSU] Retrace Pavement Marking Retroreflectivity levels in Tennessee Highways. In Collaboration with University of Tennessee Chattanooga (UTC), Funded by the Tennessee Department of Transportation (TDOT), August 15, 2013 to July 31, 2018. TSU Portion \$78,360. Deo Chimba
 - [TSU] *Deo Chimba (PI): Establishing Traffic Enforcement Performance Evaluation Standards for Tennessee. Funded by the Governors Highway Safety Office (GHSO), 10/01/2014 to 9/30/ 2015. Amount \$33,494.*

3.2 Have other collaborators or contacts been involved?

- DuPage Mayors and Managers Conference (DMMC), DuPage County Division of Transportation and FORWARD (Fighting Obesity Reaching healthy Weight Among Residents of DuPage) have been consulted to advance development of research and related projects
- Dona Sauerburger, private contract O&M instructor
- Worked with Hogeschool Utrecht, Netherlands and WMU’s Haenicke Institute for Global Education to develop a Sustainable Transportation study abroad course to be offered summer 2015.

4. IMPACT

4.1 What is the impact on the development of the principal discipline of the program?

- Non-motorized traffic safety is incorporated into CCE 4300 Traffic Design offered Fall 2014 by WMU's Department of Civil and Construction Engineering
- Non-motorized transportation research activities are incorporated into class curricula for CORP 5430 Transportation Planning offered fall 2014 by WMU's Department of Geography
- Improved recruitment of graduate students especially those interested in the transportation engineering and planning field
- The research being conducted applies directly to instruction of pedestrians who are blind, particularly those who are deaf blind, in being able to make safer crossing decisions
- The findings of the study added to the knowledge base in the discipline of Orientation and Mobility. In particular, the findings of the study provided some evidence based guidelines on what cane tip to use for efficient travel when the walking surface is covered with snow.
- Big data in transportation are usually characterized by relatively low dimensionality and huge numbers of records. To process large number of data records efficiently, one idea is to aggregate data at multiple resolutions and to explore data at various resolutions to balance between accuracy and speed. By taking multiresolution data aggregation as a common data representation, this research exploits data resolution as a new opportunity for efficient analytical processing. We have developed techniques and tools utilizing this new data representation for data visualization and statistics analysis.
- Increase transportation related research across all partner universities
- Funding of undergraduate and graduate students has oriented studies toward livable communities and transportation research.

4.2 What is the impact on other disciplines?

- TRCLC built a collaborative environment not only among TRCLC members but also researchers from other disciplines. Disciplines involved include civil engineering, computer science, electrical and computer engineering, mechanical engineering, industrial engineering, geography, urban planning, blindness and low vision studies, psychology, statistics, etc.
- Multiresolution data aggregation is a general-purpose approach to deal with the size of big relational data. We hope our effort will be helpful in setting up a primitive stage towards a rigorous framework for explorative analysis and general analytical processing of big data, with the ultimate goal of providing efficient access to big data sets in a similar role as relational table for relational database technologies today.

4.3 What is the impact on the development of transportation workforce development

- TRCLC's mobile app competition motivated high school students to pay attention on transportation issues in their daily lives and provided an opportunity to use their ideas for their communities
- Increasing awareness of the role of transportation systems on building livable communities

4.4 What is the impact on physical, institutional, and information resources at the university or other partner institutions?

- TRCLC has developed Michigan traffic crash database usable for affiliated researchers

4.5 What is the impact on technology transfer?

- Nothing to report.

4.6 What is the impact on society beyond science and technology?

- There have been many requests from communities to attend meetings for their non-motorized transportation and livability issues, and TRCLC activities helped public to understand importance of non-motorized transportation.
- Increasing awareness and knowledge regarding livable communities and strategies for advancing them.
- The findings of the study can provide guidance to blind cane users what cane tip to use when the walking surface is covered with snow.

5. CHANGES/PROBLEMS

5.1 Changes in approach and reasons for change

- Nothing to report.

5.2 Actual or anticipated problems or delays and actions or plans to resolve them

- Nothing to report.

5.3 Changes that have a significant impact on expenditures

- Nothing to report.

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

- Nothing to report.

6. SPECIAL REPORTING REQUIREMENTS

- Nothing to report.