Center for Advanced Multimodal Mobility Solutions and Education



Annual Performance Indicators Report for University Transportation Centers

October 1, 2018 to September 30, 2019

Submitted by

Center for Advanced Multimodal Mobility Solutions and Education

Prepared for

Office of the Assistant Secretary for Research and Technology (OST-R)
U.S. DEPARTMENT OF TRANSPORTATION

University of North Carolina at Charlotte (Lead)	Charlotte, NC 28223
University of Texas at Austin	Austin, TX 78712
University of Connecticut	Storrs, CT 06269
Washington State University – Pullman	Pullman, WA 99164
Texas Southern University	Houston, TX 77004



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1. PROGRAM INFORMATION

USDOT Tier 1 University Transportation Center

Annual Performance Indicators Report

Submitted to:	U.S. Department of Transportation Office of the Assistant Secretary for Research and Technology (OST-R)
Grant Number:	69A3551747133
Project Title:	Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)
Center Director:	Wei (David) Fan, Ph.D., P.E. Professor Department of Civil and Environmental Engineering University of North Carolina at Charlotte 9201 University City Blvd., Charlotte, NC 28223 wfan7@uncc.edu | 704-687-1222
Submission Date:	October 30, 2019
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EIN:	56-0791228
Recipient Organization:	University of North Carolina at Charlotte
Project/Grant Period:	November 30, 2016 - September 30, 2022
Reporting Period Start Date:	October 1, 2018
Reporting Period End Date:	September 30, 2019
Report Term or Frequency:	Annual Performance Indicators
Signature of Submitting Official:	



2. PROGRAM-WIDE INDICATORS

University Transportation Centers Program Performance Indicators

UTC Name:	Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)
University:	Lead University: • University of North Carolina at Charlotte (UNCC) Consortium Member Universities: • University of Texas at Austin (UT Austin) • University of Connecticut (UConn) • Washington State University – Pullman (WSU) • Texas Southern University (TSU)
Grant #:	69A3551747133
Reporting Period:	October 1, 2018 to September 30, 2019

Performance Indicators	Total	UNCC	UT Austin	UConn	WSU	TSU
1. Number of transportation-related courses offered during the reporting period that were taught by faculty and/or teaching assistants who are associated with the UTC						
Undergraduate courses	29	5	5	11	3	5
Graduate courses	27	4	5	10	2	6
2. Number of students participating in transportation research projects during the reporting period funded by this grant						
Undergraduate students in research	12	0	2	6	2	2
Graduate students in research	38	13	8	5	3	9
3. Number of transportation-related advanced degree programs that utilize grant funds during the reporting period to support graduate students						
Masters level programs	3	1	1	0	0	1
Doctoral level programs	6	1	1	3	1	0
4. Number of students supported by this grant during the reporting period						

Undergraduate students	11	0	1	6	2	2
Masters students	10	0	2	0	0	8
Doctoral students	23	8	6	5	3	1
5. Number of degrees awarded during the reporting period to students supported by this grant						
Undergraduate degrees	0	0	0	0	0	0
Masters degrees	6	1	2	2	0	1
Doctoral degrees	1	1	0	0	0	0
6. Number and total dollar value of research projects selected for funding during the reporting period using UTC grant funds (Federal and/or Recipient Share) that you consider to be applied research and advanced research						
Number of applied research projects	16	4	3	3	3	3
Dollar value of applied research projects	$1,357,807.06	$360,026.00	$205,020.00	$271,980.00	$239,159.00	$281,622.06
Number of advanced research projects	1	0	1	0	0	0
Dollar value of advanced research projects	$75,000.00	–	$75,000.00	-	-	-



3. UTC-SPECIFIC INDICATORS

3.1. University of North Carolina at Charlotte

Part II – UTC-Specific Performance Indicators		
UTC Name	**Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)**	
University	**University of North Carolina at Charlotte**	
Grant #	**69A3551747133**	
Reporting Period	**October 1, 2018 - September 30, 2019**	
Category	**Description of indicator**	**Metric**
1. Research Capability	• Research results published in: *Journal of Transportation Engineering, Part A: Systems, International Journal of Pavement Engineering, Journal of Transportation Safety & Security, Accident Analysis and Prevention, Journal of Modern Transportation, Canadian Journal of Civil Engineering, Transportation Research Record – Journal of Transportation Research Board, Sustainability, International Journal of Transportation Science and Technology, Computers & Industrial Engineering, IEEE Transactions on Mobile Computing (TMC), IEEE Transactions on Vehicular Technology (TVT), Personal and Ubiquitous Computing, IEEE Access, IEEE Transactions on Services Computing (TSC)*	• Number of refereed journal publications (23) 1. Gu, J.J., Jiang, Z., Fan, W., Wu, J. and Chen, J., Real-Time Passenger Flow Anomaly Detection Considering Typical Time Series Clustered Characteristics at Metro Stations, Accepted for Publication, *ASCE Journal of Transportation Engineering, Part A: Systems*, September 2019. 2. Xu, Y.L., Fan, W., Cheng, P.F. and Shan, L.Y., Mechanical Characterisation of Interface Shear Strain of Multi-Layer Composite Pavement, *International Journal of Pavement Engineering*, https://doi.org/10.1080/10298436.2019.1662905, September 2019. 3. Liu, P. and Fan, W., Analysis of Head-On Crash Severity Using A Partial Proportional Odds Model, Accepted for Publication, *Journal of Transportation Safety & Security*, https://doi.org/10.1080/19439962.2019.1667933, September 2019.



	• Research results presented at: the 19th Chinese Overseas Transportation Association (COTA) International Conference of Transportation Professionals (CICTP 2019), the 1st International Transport Frontier Seminar of Hebei Province, 1st NCDOT Research & Innovation Summit, the 2019 World Transport Convention, the Second Annual National Mobility Summit of US DOT University Transportation Centers, the COTA 22nd Annual Winter Symposium, the 98th Annual Meeting of the Transportation Research Board, the North Carolina Section of the Institute of Transportation Engineers (NCSITE) Annual Meeting, the 6th Annual UTC Conference for the Southeastern Region, IEEE 38th Conference on Computer Communications (INFOCOM 2019), IEEE International Performance Computing and Communications Conference (IPCCC 2018)	4. Li, Y. and Fan, W., Modelling Severity of Pedestrian-Injury in Pedestrian-Vehicle Crashes with Latent Class Clustering and Partial Proportional Odds Model: A Case Study of North Carolina, *Accident Analysis and Prevention*, July 2019. Volume 131, pp. 284-296, 2019. 5. Chen, Z. and Fan, W., Data Analytics Approach for Travel Time Reliability Pattern Analysis and Prediction, *Journal of Modern Transportation*, https://doi.org/10.1007/s40534-019-00195-6, pp. 1-16, 2019. 6. Teng, J., Chen, T. and Fan, W., An Integrated Approach to Vehicle Scheduling and Bus Timetabling for an Electric Bus Line, Accepted for Publication, *ASCE Journal of Transportation Engineering, Part A: Systems*, July 2019. 7. Lin, Z. and Fan, W., Cyclist Injury Severity Analysis with Mixed Logit Models at Intersections and Non-intersection Locations, *Journal of Transportation Safety & Security*, https://doi.org/10.1080/19439962.2019.1628140, May 2019. 8. Zhu, W., Wei, J. and Fan, W., Data Fusion Approach for Evaluating Route Choice Models in Large-Scale Complex Urban Rail Transit Networks, Accepted for Publication, *ASCE Journal of Transportation Engineering, Part A: Systems*, April 2019. 9. Lin, Z. and Fan, W., Modeling Bicyclist Injury Severity in Bicycle-Motor Vehicle Crashes Occurred in Both Urban and Rural Areas: A Mixed Logit Analysis, Accepted for Publication, *Canadian Journal of Civil Engineering*, March 2019. 10. Li, Y. and Fan, W., Pedestrian-Injury Severities in Pedestrian-Vehicle Crashes and the Partial Proportional Odds Logit Model: Accounting for Age Difference, *Transportation Research Record – Journal of Transportation Research Board*, https://doi.org/10.1177/03611981



		19842828, Vol. 2673, No. 5, pp. 731-746, 2019. 11. Chen, Z. and Fan, W., Modeling Pedestrian-Vehicle Crash Severity in Rural and Urban Areas: Mixed Logit Model Approach, *Transportation Research Record – Journal of Transportation Research Board*, https://doi.org/10.1177/03611981 19842825, Vol. 2673, No. 4, pp. 1023-1034, 2019. 12. Yu, M. and Fan, W., Optimal Variable Speed Limit Control in Connected Autonomous Vehicle Environment for Relieving Freeway Congestion, *ASCE Journal of Transportation Engineering, Part A: Systems*, 145(4): 04019007, http://doi.org/10.1061/JTEPBS.00 00227, April, 2019. 13. Liu, P. and Fan, W., Modeling Head-On Crash Severity on NCDOT Freeways: A Mixed Logit Model Approach, *Canadian Journal of Civil Engineering,* https://doi.org/10.1139/cjce-2018-0262, Vol. 46, No. 4, pp. 322-328, 2019. 14. Huang, Z.Y., Xu, R.H., Fan, W., Zhou, F. and Liu, W., Service-Oriented Load Balancing Approach to Alleviating Peak-Hour Congestion in Metro Network Based on Multi-Path Accessibility, *Sustainability*, 11, 1293, http://doi.org/10.3390/su1105129 3, 2019. 15. Chen, Z. and Fan, W., A Multinomial Logit Model of Pedestrian-Vehicle Crash Severity in North Carolina, *International Journal of Transportation Science and Technology*, Volume 8, Issue 1, pp. 43-52, 2019. 16. Jiang, Z.B., Gu, J.J., Fan, W., Liu, W. and Zhu, B.Q. Q-Learning Approach to Coordinated Optimization of Passenger Inflow Control with Train Skip-stopping on a Urban Rail Transit Line, *Computers &*



		Industrial Engineering, Volume 127, pp. 1131-1142, 2019. 17. Hanshang Li, Ting Li, Weichao Wang, Yu Wang, "Dynamic Participant Selection for Large-Scale Mobile Crowd Sensing", To appear in *IEEE Transactions on Mobile Computing (TMC)*. 18. Fan Li, Xiaoyu Song, Huijie Chen, Xin Li, Yu Wang, "Hierarchical Routing for Vehicular Ad Hoc Networks via Reinforcement Learning", *IEEE Transactions on Vehicular Technology (TVT)*, Volume: 68, Issue: 2, Pages: 1852-1865, February 2019. 19. Jiahui Chen, Fan Li, Huijie Chen*, Song Yang, Yu Wang, "Dynamic Gesture Recognition Using Wireless Signals with Less Disturbance", *Personal and Ubiquitous Computing*, Volume: 23, Issue: 1, Pages: 17-27, February 2019. 20. Zhixin Liu, Xi Han, Yang Liu, Yu Wang, "D2D-Based Vehicular Communication with Delayed CSI Feedback", *IEEE Access*, Volume: 6, Issue: 1, Pages: 52857-52866, December 2018. 21. Youqi Li, Fan Li, Song Yang, Yue Wu, Huijie Chen, Kashif Sharif, Yu Wang, "MP-Coopetition: Competitive and Cooperative Mechanism for Multiple Platforms in Mobile Crowd Sensing", To appear in *IEEE Transactions on Services Computing* (TSC). 22. Aurobinda Laha, Bo Yin, Yu Cheng, Lin X. Cai, Yu Wang, "Game Theory Based Charging Solution for Networked Electric Vehicles: A Location-Aware Approach", *IEEE Transactions on Vehicular Technology* (TVT), Volume: 68, Issue: 7, Pages: 6352-6364, July 2019. 23. Yang Liu, Lili Hao, Zhixin Liu, Kashif Sharif, Yu Wang, Sajal Das, "Mitigating Interference via Power Control for Two-Tier Femtocell Networks: A

		Hierarchical Game Approach", *IEEE Transactions on Vehicular Technology* (TVT), Volume: 68, Issue: 7, Pages: 7194-7198, July 2019. • Number of conference papers presented, and other presentations made (27) • Number of technical research reports published (5) 1. Fan, W. and Chen, Z, *Use of Multisensor Data in Modeling Freeway Travel Time Reliability*, Technical Report for CAMMSE Research 2018 Project 01, U.S. Department of Transportation, September 2019. 2. Fan, W. and Li, Y, *Using General Transit Feed Specification (GTFS) Data as a Basis for Evaluating and Improving Public Transit Equity*, Technical Report for CAMMSE Research 2018 Project 02, U.S. Department of Transportation, September 2019. 3. Fan, W. and Lin, Z., *Evaluating the Potential Use of Crowdsourced Bicycle Data in North Carolina*, Technical Report for CAMMSE Research 2018 Project 03, U.S. Department of Transportation, September 2019. 4. Fan, W. and Liu, P., *Impact of Connected and Automated Vehicles (CAVs) on Freeway Capacity*, Technical Report for CAMMSE Research 2018 Project 04, U.S. Department of Transportation, September 2019. 5. Fan, W. and Yu, M, *Optimal Variable Speed Limit Control for the Mixed Traffic Flows in a Connected and Autonomous Vehicle Environment*, Technical Report for CAMMSE Research 2018 Project 05, U.S. Department of Transportation, September 2019.



2. Leadership	• Handling Editor, *TRR Inaugural Editorial Board, Transportation Research Record* • Associate Editor, *IEEE Transactions on Intelligent Transportation Systems*, and *ASCE Journal of Transportation Engineering, Part A: Systems,* and *International Journal of Transportation Science and Technology* • Editorial Board, *Journal of World Review of Intermodal Transportation Research*, and *International Journal of Transportation* • Area Editor of "Connected and Autonomous Vehicles," 19th COTA conference International Conference of Transportation Professionals (CICTP2019) • Organizer/Coordinator for 2019 CAMMSE Transportation Summer Camp, and STEM Blasters • Chair of Session and Symposium Steering Committee Member of "Connected and Autonomous Vehicles," The 22nd COTA Winter Symposium • Co-Chair of Connected Autonomous Vehicles Section, 2019 World Transport Convention (WTC), Co-General Chair of the 6th International Workshop on Crowd Assisted Sensing, Pervasive Systems and Communications (CASPer 2019), Co-General Chair of the IEEE 38th International Performance Computing and Communications Conference (IPCCC 2019) • Member, WTC Shared Logistics and Transportation Systems, ASCE National Connected & Autonomous Vehicles Impacts	• Editorship (6) • Organizing committee member, session chair or area editor of conference (7) • Number of professional committees or board member (10) • Number of review panels (3)

	Committee, ASCE National Advanced Technologies Committee, NCDOT Fully Autonomous Vehicle (FAV) Research Working Group Committee, Sustain Charlotte Transportation Choices Alliance Advisory Council, ASCE National Public Transport Committee, ASCE National Rail Transportation Committee, NCSITE Scholarship Committee, TRB AHB60 Standing Committee, and Professional Engineers of North Carolina (PENC) State Board • Panel Member, NCHRP Synthesis 20-05/Topic 50-10, NCHRP 08-116, NCHRP 03-131	
3. Education and Workforce Development	• Three existing undergraduate courses and four existing graduate courses • Eight graduate students in CAMMSE projects. • Two degree programs in the College of Engineering in the Department of Civil and Environmental Engineering at UNC Charlotte • UNC Charlotte Transportation Summer Camp in 2019, STEM Blasters Educational activity for High School students in 2019 • Reached out to several Middle and High schools in the Charlotte-Mecklenburg Schools (CMS) and Cabarrus school system • Six UNC Charlotte ITE student chapter bi-weekly seminars and twenty-nine UNC Charlotte transportation graduate students weekly seminars	• Transportation related courses offered by faculty (7) • Number of students participating in CAMMSE funded projects (8) • Number of transportation related degree programs with students funded by CAMMSE (2) • Number of graduated students (2) • Number of transportation summer institute/camp (2) • Number of research symposium (1) • Number of transportation summer campers (23) • Number of transportation seminars (35) • Student scholarships or awards (2) 1. Miao Yu, *Outstanding Civil and Environmental Engineering Department Graduate Ph.D. Student Award* at UNC Charlotte, December 2018

		2. Pengfei Liu, *Second Place Award Winner* at the 2019 Civil and Environmental Engineering Graduate Research Symposium, UNC Charlotte, September 2019
4. Technology Transfer	• Nine invited presentations at seven different universities in China (South China University of Technology, Wuhan University of Science and Technology, Tongji University, Shijiazhuang Tiedao University, Hebei University of Technology, Qilu University of Technology, Beijing University of Posts and Telecommunications), and also at the University of Texas at Arlington and Illinois Institute of Technology • One other invited presentation at the Second Annual National Mobility Summit of USDOT University Transportation Centers • Eighteen presentations at various conferences (e.g., CICTP 2019, 2019 WTC, COTA M3 2019, 98th TRB 2019, NCSITE 2019 as mentioned in the "Research Capability" section	• Presentations given at professional and academic meeting (28) • Number of professionals in the audience (est. 1000)
5. Collaboration	• North Carolina DOT, North Carolina Turnpike Authority Automated Vehicle Proving Ground, North Carolina A&T State University, and North Carolina State University in collaborative research and UNC Charlotte in providing cash, in-kind support, facilities, etc. • Research Collaboration with South China University of Technology, Wuhan University of Science and Technology, Tongji University, Shijiazhuang Tiedao University, Hebei University of Technology, Qilu University of Technology, Beijing University of Posts and Telecommunications, and also the University of Texas	• Number of collaborative partners (5) • Number of national and international collaboration (9) • Number of Center personnel involved (5)

	at Arlington and Illinois Institute of Technology • Center personnel: Dr. Wei Fan, Dr. Miguel Pando, Dr. David Weggel, Dr. Martin Kane, and Dr. Yu Wang	



3.2. University of Texas at Austin

Part II – UTC-Specific Performance Indicators		
UTC Name	**Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)**	
University	**University of Texas at Austin**	
Grant #	**69A3551747133**	
Reporting Period	**October 1, 2018 - September 30, 2019**	
Category	**Description of indicator**	**Metric**
1. Research Capability	• Research results published in: *IFAC-PapersOnLine* • Research results presented at: the 98th Annual Meeting of the Transportation Research Board, the 21st International Conference on Intelligent Transportation Systems, the 2018 Annual Meeting of the Institute of Operations Research and Management Sciences	• Number of refereed publications (1) 1. Liu, H., Claudel, C., and Machemehl, R. B. A Stochastic Formulation of the Optimal Boundary Control Problem Involving the Lighthill Whitham Richards Model. *IFAC-PapersOnLine*, 51(9), 337-342. • Number of refereed conference proceedings (2) 1. Yahia, C. N., S. Scott, S. D. Boyles, and C. Claudel. (2019) Unmanned aerial vehicle path planning for traffic estimation and detection of non-recurrent congestion. 98th Annual Meeting of the Transportation Research Board, Washington, DC. 2. Liu, Hao; Chen, Amber; Machemehl, Randy, An Adaptive Signal Control Method Using Cell Transmission Model and Mixed Integer Linear Programming. Transportation Research Board 98th Annual Meeting. Transportation Research Board, 2019. • Number of conference papers presented, and other presentations made (5)

		• Number of technical research reports published (6) 1. Mohamed A. A., Claudel, C., IEA: Inner Ensemble Average within a convolutional neural network. arXiv preprint arXiv:1808.10350. 2. Mohamed A. A., Claudel, C. MCRM: Mother Compact Recurrent Memory A Biologically Inspired Recurrent Neural Network Architecture. arXiv preprint arXiv:1808.02016. 3. Fu, Mengyu and Randy Machemehl, *Characterization of Bicycle Rider Behavior among Various Street Environments*, Technical Report for CAMMSE Research 2018 Project 06, U.S. Department of Transportation, September 2019. 4. Alrashidan, Ahmed and Randy Machemehl, *Evolution of Advanced Signal Priority with Gap-Based Signal Recovery Strategy*, Technical Report for CAMMSE Research 2018 Project 07, U.S. Department of Transportation, September 2019. 5. Boyles, Stephen and Cesar Yahia, *Assessment of Parcel Delivery Systems Using Unmanned Aerial Vehicles*, Technical Report for CAMMSE Research 2018 Project 08, U.S. Department of Transportation, September 2019. 6. Claudel, Christian and Abdullah Adel, *User Trajectory Estimation from Visual Features: Development of Inner-Ensemble Averaging (IEA) for Deep Learning*, Technical Report for CAMMSE Research 2018 Project 09, U.S. Department of Transportation, September 2019.
2. Leadership	• Associate Editor, *ITE Journal - Institute of Transportation Engineers* • Editorial Board, *Transportation Research Part B, Transportation Research Part C, Journal of Infrastructure Systems*	• Editorship (5) • Organizing committee member, session chair or area editor of conference (1)



	• Chair, Transportation Research Board, Transit, Freight, and Logistics Subcommittee • Member, Transportation Research Board, Transportation Network Modeling Committee	• Number of professional committees or board member (2)
3. Education and Workforce Development	• Two undergraduate courses and five graduate courses • Three undergraduate student and eight graduate students in CAMMSE projects • One degree program in the Cockrell School of Engineering in the Civil, Architectural and Environmental Engineering Department	• Transportation related course offered by faculty (7) • Number of students participating in CAMMSE funded projects (10) • Number of transportation related degree programs with students funded by CAMMSE (1)
4. Technology Transfer	• Two MS students have graduated this past year. The CAMMSE-supported students that have graduated during this reporting period will carry the new technology that they have developed with them for the rest of their careers	• Number of graduated students (2) • Number of presentations (2)
5. Collaboration	• City of Austin and Capital Metropolitan Transportation Authority in collaborative research and UT's Center for Transportation Research providing in-kind support, facilities, etc. • NSF in collaborative research • Center personnel: Dr. Randy Machemehl, Dr. Stephen Boyles, Dr. Christian Claudel, Carolina Baumanis	• Number of collaborative partners (3) • Number of Center personnel involved (4)



3.3. University of Connecticut

Part II – UTC-Specific Performance Indicators		
UTC Name	**Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)**	
University	**University of Connecticut**	
Grant #	**69A3551747133**	
Reporting Period	**October 1, 2018 to September 30, 2019**	
Category	**Description of indicator**	**Metric**
1. Research Capability	• Research results published in: *Transportation Research Record – Journal of Transportation Research Board, Transfers* • Research results presented at 98th TRB 2019, Federal Highway Administration Transportation Policy Symposium 2019, ASCE International Conference on Transportation and Development 2019, ITE Northeastern District Annual Meeting 2019, Swiss Transportation Research Council 2018, Central Connecticut State University Sustainability Forum 2019, CAV101 Seminars 2019, ROBOTICA Autonomous Vehicle Summit 2019, and Quality and Productivity Research Conference 2019	• Number of refereed journal publications (3) 1. Atkinson-Palombo, C., Varone, L., and Garrick, N. W. Understanding the Surprising and Oversized Use of Ridesourcing Services in Poor Neighborhoods in New York City. *Transportation Research Record*, 0361198119835809. 2019. 2. Clark, A., Atkinson-Palombo, C., Garrick, N.W. The Rise and Fall of the Segway. *Transfers*. 2019 (Accepted). 3. Wang, Q., and Lownes, N. E. All-Links-Based E-Hailing Pricing and Surcharge Mechanism for Transportation System Performance Improvement. *Transportation Research Record*, 0361198119850799. 2019. • Number of conference papers presented, and other presentations made (17) • Number of technical research reports published (3) 1. Lownes, N., Bertolaccini, K. and Smith, R., *Investigating the Linkage Between Transit Access to Services and Affordable Housing Availability*, Technical Report for CAMMSE Research

		Project 2018 Project 10, September 2019. 2. Konduri, K., *Development of Continuous Time, Temporally Constrained and Behaviorally Consistent Tour Pattern Generation System for Modeling the Impacts of Autonomous Vehicle Future*, Technical Report for CAMMSE Research Project 2018 Project 11, September 2019. 3. Garrick, N. and Atkinson-Palombo, C, *What Do We Want from Autonomous Vehicles (AVs)? Using Participatory Planning and Scenario Analysis of Alternative Features to Identify Stakeholders' Desired Outcomes from the Strategic Deployment of Emerging Transportation Technology*, Technical Report for CAMMSE Research Project 2018 Project 12, September 2019.
2. Leadership	• Associate Editor, *Transportation Letters* • Session Chair INFORMS; Paper Review Coordinator TRB Standing committees AP025, ADB10; ASCE Big Data and Analytics for Rail and Public Transit • Member, TRB Standing Committees (AP025, ADB10), ASCE Public Transportation Committee, Connecticut Transportation Institute	• Editorship (1) • Organizing committee member or subcommittee chair of conference or workshop (4) • Number of professional committees or affiliated centers (4)
3. Education and Workforce Development	• Eleven undergrad course offerings and ten graduate course offerings • Five graduate students in CAMMSE projects, six undergraduate students • Three doctoral level degree programs in civil engineering, geography and statistics	• Transportation related courses offered by faculty (21) • Number of students participating in CAMMSE funded projects (11) • Number of transportation related degree programs with students funded by CAMMSE (3)



4. Technology Transfer	• A one-day conference focusing on “Putting Humans in the AV Drivers’ Seat: People, Policy & Law” and community conversation about “What does the public want from Autonomous Vehicles” were held by UConn	• Number of events held (2) • Number of professionals in the audience (est. 200)
5. Collaboration	• Connecticut DOT, partnership for Strong Communities, University of Queensland • Dissertation Reviewer, UNSW; Research Collaboration with University of Queensland • Center personnel: Dr. Nicholas Lownes, Dr. Karthik Konduri, Dr. Garrick Norman, and Dr. Carol Atkinson-Palombo	• Number of collaborative partners (3) • Number of international collaboration (2) • Number of Center personnel involved (4)



3.4. Washington State University – Pullman

Part II – UTC-Specific Performance Indicators		
UTC Name	**Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)**	
University	**Washington State University – Pullman**	
Grant #	**69A3551747133**	
Reporting Period	**October 1, 2018 to September 30, 2019**	
Category	**Description of indicator**	**Metric**
1. Research Capability	• Research results published in: *International Journal of Industrial Organization; Transportation Research Board* • Research results presented at: the 98th TRB Annual Meeting, 3rd Simpson Strong-Tie Annual Building Connections Student Symposium, the CESTiCC-CAMMSE-TRB webinars, ACWA Stormwater Summit, etc.	• Number of refereed journal publications (2) 1. Yan, J., Fu, X., Oum, T. H., & Wang, K. (2019). Airline horizontal mergers and productivity: Empirical evidence from a quasi-natural experiment in China. *International Journal of Industrial Organization*, *62*, 358-376. 2. Akin, M., Fay, L., Shi, X. Friction and Snow-Pavement Bond after Salting and Plowing Permeable Friction Surfaces. *Transportation Research Record*, 2019, in press. • Number of presentations (17) • Number of technical research reports published (2) 1. Akin, M., Zhang, Y. and Shi, X., *Developing Friction Data to Support the Optimal Use of Pre-Wet Deicing Salt for Enhanced Winter Mobility*, Technical Report for CAMMSE Research 2018 Project 16, U.S. Department of Transportation, October 2018. 2. Chen, C. and Shi, X., *Modeling the Macroscopic Effects of Winter Maintenance Operations on Traffic Mobility on Washington Highways*, Technical Report for CAMMSE Research 2018 Project



		17, U.S. Department of Transportation August 2019.
2. Leadership	• Editor-in-Chief of *Journal of Infrastructure Preservation and Resilience*; Editorial Board of *Transportmetrica*; Editorial Board of *International Journal of Transportation Science and Technology* • Dissertation award committee of the Hong Kong Society of Transportation Studies • Organizing committee, 2019 International Conference on Transportation Infrastructure and Materials, July 2-4, 2019, Jinan, China • Session Chair and Co-Chair of Subcommittee, 3rd World Transport Convention, June 13-16, 2019, Beijing, China • ASCE Construction Institute (CI) Bituminous Materials Committee, Control Member • Member of TRB Committees: *AFN30 and ADC60*	• Editorship (3) • Organizing committee member or subcommittee chair of conference or workshop (2) • Number of professional committees or affiliated centers (3)
3. Education and Workforce Development	• Taught the following courses related to transportation: CE322 Transportation Engineering 80 students; CE472 Durable/Sustainable Pavements & Bridges, 36 students; CE498 Traffic Operations, 20 students; CE501-02 Traffic Operations, 6 students; CE 501-01 – Distributed Optimization and Coordination Algorithms for Transportation Systems, 5 students • Supported 3 Ph.D. students, and 2 undergraduate students in CAMMSE funded projects • K-12 outreach activities and demonstrations at the 9th Annual Nez Perce STEM Fair, Dec. 6, 2018	• Transportation related courses offered by faculty (5) • Student scholarships or awards (11) 1. Yan Zhang, 2018 Outstanding Student Award, 3rd Place, selected by the International Association of Chinese Infrastructure Professionals (IACIP) 2. Jialuo He, Best Poster Award, 1st Place, the 2019 Annual Workshop of International Association of Chinese Infrastructure Professionals (IACIP), Washington, D.C. 3. Sen Du, Richard Perteet Graduate Fellowship in Civil Engineering, WSU, 2019 4. Yan Zhang, Howard & Martha Copp Scholarship, WSU, 2019 5. Mehrzad Mehrabipour,

	• Elementary-age outreach activities via the STEAM Coalition • One female minority undergraduate (civil engineering) student (Nicole Kim, WSU), and another female undergraduate student (Olivia Willis) were involved in CAMMSE 2019 Project 15 • Starting August 2019, a female international Ph.D. student (Aya Shatanawi, from Jordan) joined the Transportation Engineering PhD. Program and she has been contributing to the CAMMSE research projects	6. Rasool Mohebifard, President leadership Award, WSU, 2019. Washington State University Outstanding Research Assistant Excellence Award, WSU, 2019 7. Rasool Mohebifard, Civil and Environmental Engineering Department Outstanding Teaching Assistant Award, WSU, 2019. 8. Mehrzad Mehrabipour,Helene M. Overly Memorial Scholarship, Women's Transportation Seminar Scholarships, Puget Sound Chapter, 2019. 9. Rasool Mohebifard, Perteet Engineering Graduate Fellowship in Civil Engineering, WSU, 2019. 10. Mehrdad Tajalli, Perteet Engineering Graduate Fellowship in Civil Engineering, WSU, 2019. 11. Rasool Mohebifard, Ph.D. Student Workshop on Transportation and Logistics Challenges and Opportunities travel scholarship, National Science Foundation, 2019. • Number of students participating in CAMMSE funded projects (5) • Number of transportation related degree programs with students funded by CAMMSE (1)
4. Technology Transfer	• Invited presentations at: Changsha University of Technology, Yunan Institute of Building Sciences, Beihang University, Beijing University of Science and Technology, and ACWA Stormwater Summit by Oregon Association of Clean Water Agencies	• Presentations given at professional and academic meetings (17) • Number of professionals in the audience (410)
5. Collaboration	• Visiting professor at Wuhan Polytechnic University, China • Active member of the Palouse STEAM Coalition, coordinating quarterly forums with keynote speakers and professional	• Number of collaborative partners (8) • Number of international collaboration (4) • Number of Center personnel involved (3)

	development hours for in-service teachers • Hosted three visiting scholars from Harbin Institute of Technology, Wuhan University of Science and Technology, and Central South University of Forestry & Technology, China, respectively • Oregon State University, and University of Washington: the collaborators have been involved in the CAMMSE related activities mainly by contributing domain knowledge or exchanging the latest information on connected vehicle technologies • The PacTrans: Region 10 UTC has been involved by sharing the interests in exploring CV technologies for better winter road maintenance operations and in reaching out to K-12 groups • Center personnel: Dr. Ali Hajibabaie, Michelle Akin, Dr. Xianming Shi	

3.5. Texas Southern University

Part II – UTC-Specific Performance Indicators		
UTC Name	**Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE)**	
University	**Texas Southern University**	
Grant #	**69A3551747133**	
Reporting Period	**October 1, 2018 to September 30, 2019**	
Category	**Description of indicator**	**Metric**
1. Research Capability	• Research results published in: *Journal of Transportation Engineering, Part A, Journal of the Air & Waste Management Association* • Research results presented at: The *98th TRB Annual Meeting* • Technical reports for CAMMSE: "*Determination of Freeway Acceleration Lane Length for Vehicle Safe Merging", "Innovative Countermeasures for Reducing the Truck Waiting Time at Marine Terminals", and "Investigating the Impact of Different Attributes on Bicycling Mode Share as A Multimodal Connectivity Strategy in Large Cities: A Case Study in Houston"*	• Number of refereed journal publications (2) 1. Zang, J., G. Song, R. E, J. Sun, X. Zhang, L. Yu. Experimental Findings of Wide Moving Jam: A case study in Beijing. Accepted for Publication in *Journal of Transportation Engineering, Part A: Systems*, 2018. 2. Sun, X., X. Chen, Y.Qi, B. Mao, L.Yu and P. Tang. "Effects of Advanced Traffic Signal Status Warning Systems on Vehicle Emission Reductions at Signalized Intersections", *Journal of the Air & Waste Management Association*, Vol. 69, Issue 4, pp. 391-401, 2019. • Number of conference papers presented (3) • Number of technical reports (3) 1. Qi, Y., Zhao, Q., Liu, S. and Li, J. *Determination of Freeway Acceleration Lane Length for Vehicle Safe Merging*, Technical Report for CAMMSE Research Project 2018 Project 13, September 2019. 2. Qi, Y., Zhao, Q., Azimi, M. and Jinna, H. *Innovative Countermeasures for Reducing the Truck Waiting Time at Marine Terminal*", Technical Report for

		CAMMSE Research Project 2018 Project 14, September 2019. 3. Azimi, M., Lan, L. and Qi, Y. *Investigating the Impact of Different Attributes on Bicycling Mode Share as A Multimodal Connectivity Strategy in Large Cities: A Case Study in Houston*, Technical Report for CAMMSE Research Project 2018 Project 15, September 2019.
2. Leadership	• Editorial Board, *International Journal of Transportation Science and Technology* • Editorial Advisory Board member of *Asian Transport Studies*; Editorial Board, *Journal of Transportation Research Part D* • Transportation Research Board (TRB) Standing Committee on Intermodal Freight Terminal Design and Operations (AT050), Ports and Channel (AW010), Inland Water Transportation (AW020); Member, Maritime Education, Training, and Outreach subcommittee of the Lone Star Harbor Safety Committee (LSHSC) • CAMMSE funded students received notable national and regional awards including: *Texas ITE Houston Section Scholarship (2), and TSU university scholarship (2)*	• Editorship (3) • Number of professional committees or affiliated centers (4) • Number and type of notable national and regional awards (4)
3. Education and Workforce Development	• Five existing undergrad courses and six existing graduate courses • Nine graduate students and two undergraduate students involved in CAMMSE projects • One undergraduate degree program and one graduate degree program in the College of Science, Technology and Engineering at TSU • One master thesis directly supported by CAMMSE "*Signal*	• Transportation related courses offered by faculty (11) • Number of faculty in transportation areas (4) • Number of students participating in CAMMSE funded projects (11) • Number of transportation related degree programs with students funded by CAMMSE (2)

	Design and Timing for Continuous Flow Intersection"	• Number of master thesis (1)
4. Technology Transfer	• Conference Presentation (the TRB 98th Annual Meeting)	• Presentations given at professional and academic meeting (3)
5. Collaboration	• Collaborate with Houston-Galveston Area Council (HGAC) to provide internship positions to graduate students • Collaborate with University of Houston, Case Western Reserve University on two national NSF proposals • Collaborate with University of Texas at El Paso and University of Houston on two TxDOT Proposals • Center personnel: Dr. Yi Qi, Dr. Lei Yu and Dr. Mehdi Azimi	• Number of collaborative partners (5) • Number of Center personnel involved (3)

Center for Advanced Multimodal Mobility Solutions and Education