

**U.S. Department of Transportation  
Research and Innovative Technology Administration  
University Transportation Center Grant Agreement**

**Grant No. DTRT12-G-UTC08  
Mountain-Plains Consortium, North Dakota State University Denver Tolliver,  
Director [Denver.tolliver@ndsu.edu](mailto:Denver.tolliver@ndsu.edu)  
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**North Dakota State University  
Upper Great Plains Transportation Institute  
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**Grant period: January 1, 2012 – January 31, 2016**

**Reporting Period End Date: June 30, 2015  
Semi-Annual PPR#7**

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## 1. Accomplishments: What was done? What was learned?

### a. What are the major goals of the program?

The overall objectives are to: (1) conduct basic and applied research, the products of which are judged by peers or other experts in the field of transportation to advance the body of knowledge in transportation; (2) offer an education program in transportation that includes multidisciplinary course work and participation in research; (3) conduct workforce development activities and programs to expand the workforce of transportation professionals; (4) provide an ongoing program of technology transfer to make transportation research results available to potential users in a form that can be readily used; and (5) provide planning and technical assistance to Native American tribes, especially those heavily impacted by energy development. Other program goals are to select projects and activities using peer review principles and procedures and client input that: (1) address the Secretary's strategic goals, and (2) leverage UTC funds with matching funds from state and local governments and private industry. The chief operational goals for grant DTRT12-G-UTC08 is to make important contributions to research and technology transfer in key areas related to the Secretary's goals of State of Good Repair, Safety, and Economic Competitiveness, while addressing critical issues of the region and stakeholder groups—especially issues in the rapidly growing Bakken oil production region.

### b. What was accomplished under these goals?

#### i. Project Selection and Peer Review

Under grant DTRT12-G-UTC08, 87 research projects have been selected from federal fiscal year (FY) 2012 and 2013 funds. All projects have been selected through a peer review process that reflects substantial input and matching resources from state departments of transportation and other transportation agencies in the region. The projects selected under grant DTRT12-G-UTC08 are listed in Tables 1-7, under the primary strategic goal addressed by the project. Please note that many of the projects address several goals simultaneously. In particular, many projects that address State of Good Repair have potential Safety and Economic Competitiveness benefits.

**Table 1: MPC Research Projects Most Directly Correlated with Sustainability**

1. MPC-354: Geotechnical Limit to Scour at Spill-through Abutments (Year 2)
2. MPC-361: Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit in Denver, Colorado
3. MPC-364: Do Changing Prices Portend a Shift in Fuel Consumption, Diminished Greenhouse Gas Emissions, and Lower Fuel Tax Revenue?
4. MPC-390: Design and Construction Monitoring of Surcharged Embankment
5. MPC-392: Evaluation of Spliced Sleeve Connections for Precast Reinforced Concrete Bridge Piers
6. MPC-393: Traffic Modeling of Transit Oriented Development
7. MPC-396: Extent, Severity, and Location of Chip Seal Loss on the South Dakota State Road Network

**Table 2: MPC Research Projects Most Directly Correlated with Safety**

1. MPC-354: Geotechnical Limit to Scour at Spill-through Abutments (Year 2)
2. MPC-366: Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks, Phase I – Instrumentation Development and Validation
3. MPC-367: Developing Statistical Models for Crash Severity Comparing Statewide, County and Indian Reservation Roads
4. MPC-368: Teen Drivers: Crash Factor Analysis
5. MPC-373: Damage Assessment, Characterization, and Modeling for Enhanced Design of Concrete Bridge Decks in Cold Regions
6. MPC-375: Small Railroad Capital Investment Needs and Financial Options
7. MPC-378: MEMS Sensors for Transportation Structures

8. MPC-380: Investigation of Interactions Between Traffic Law Enforcement and Driving Behavior on Rural Highways in Colorado
9. MPC-381: Performance-based Interaction Analysis of Damage on Bridge Expansion Joints and Heavy Traffic
10. MPC-382: Seismic Behavior of Steel Bridges with Fatigue-prone Details
11. MPC-386: Use of Travel Time, Travel Time Reliability, and Winter Condition Index Information for Improved Operation of Rural Interstates
12. MPC-397: Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
13. MPC-386: Use of Travel Time, Travel Time Reliability, and Winter Condition Index Information for Improved Operation of Rural Interstates
14. MPC-397: Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
15. MPC-402: Seismic Performance of SCC Bridge Columns
16. MPC-406: Risk- and Reliability-Based Approaches to Analyzing Road Geometric Design Criteria
17. MPC-407: The Effect of Multi-tasking on Self-Assessments of Driving Performance Center for the Prevention of Distracted Driving
18. MPC-408: Exploring Unique Plastic-Reinforced Bridge Decks: Phase I
19. MPC-409: Identification of Low-Risk Adjusted Work Schedules Designed to Manage Fatigue During Peak Service Demand Periods in the Short line Railroad Industry
20. MPC-416: Development and Testing of Crashworthy Ipe Bridge Rails
21. MPC-418: 400 South Corridor Assessment
22. MPC-425: Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
23. MPC-431: Connected Vehicle Weather Data for Operation of Rural Variable Speed Limit Corridors
24. MPC-433: Real-Time Traffic Management to Maximize Throughput of Automated Vehicles
25. MPC-434: A Bicycle Network Analysis Tool for Planning Applications in Small Communities
26. MPC-435: Realization of a Coarse Position Verification System for an Automated Highway System
27. MPC-438: Calibration of HSM Predictive Methods on Rural State and Local Highways
28. MPC-445: A Sensor Fusion Approach to Assess Pavement Condition and Maintenance Effectiveness

**Table 3: MPC Research Projects Most Directly Correlated with State of Good Repair**

1. MPC-354: Geotechnical Limit to Scour at Spill-through Abutments (Year 2)
2. MPC-366: Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks, Phase I – Instrumentation Development and Validation
3. MPC-373: Damage Assessment, Characterization, and Modeling for Enhanced Design of Concrete Bridge Decks in Cold Regions
4. MPC-375: Small Railroad Capital Investment Needs and Financial Options
5. MPC-378: MEMS Sensors for Transportation Structures
6. MPC-379: Plastic-Aluminum Composites in Transportation Infrastructure
7. MPC-382: Seismic Behavior of Steel Bridges with Fatigue-prone Details
8. MPC-383: Seismic Performance of Highway Embankments
9. MPC-387: Comprehensive GIS-Based Rural Regional Transportation Planning Models
10. MPC-390: Design and Construction Monitoring of Surcharged Embankment
11. MPC-394: Quantifying Uncertainty in Nondestructive Bridge Inspection Methods for use in Performance Based Inspection
12. MPC-394: Quantifying Uncertainty in Nondestructive Bridge Inspection Methods for use in Performance Based Inspection
13. MPC-395: Accelerated Bridge Construction in South Dakota: Pilot Study for Implementation Strategy
14. MPC-396: Extent, Severity, and Location of Chip Seal Loss on the South Dakota State Road Network
15. MPC- MPC-397: Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
16. MPC-400: Evaluation of Ice Loads on Bridge Piers in South Dakota (Years 2 & 3)
17. MPC-402: Seismic Performance of SCC Bridge Columns
18. MPC-404: Seismic Performance of Concrete Filled Steel Tube (CFST) Bridge Columns for Accelerated

## Bridge Construction

19. MPC-405: Seismic Retrofit of Spliced Sleeve Connections for Precast Bridge Piers
20. MPC-406: Risk- and Reliability-Based Approaches to Analyzing Road Geometric Design Criteria
21. MPC-409: Identification of Low-Risk Adjusted Work Schedules Designed to Manage Fatigue during Peak Service Demand Periods in the Shortline Railroad Industry
22. MPC-410: Predicting Fatigue Service Life Extension of RC Bridges with Externally Bonded CFRP Repairs
23. MPC-411: Re-Use of Mine Waste Materials Amended with Fly Ash in Transportation Earthwork Projects
24. MPC-412: Fatigue Strength of CFRP-repaired Reinforced Concrete Bridge Girders under Service Temperature
25. MPC-414: Quantifying Sustainability Metrics for Trunkline Bridges in the Mountain Plains Region
26. MPC-415: Framework of Performance-Based Earthquake Design of Curved and Skewed Bridges
27. MPC-419: Experimental and Numerical Study for the Debonding Interface between an Existing Pavement and a New Concrete Overlay
28. MPC-421: Seismic Rehabilitation of Skewed and Curved Bridges Using a New Generation of Bulking Restrained Braces
29. MPC-422: Highway Structures Supported on Expanded Polystyrene (EPS) Embankment without Deep Foundations
30. MPC-425: Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
31. MPC-427: Fire Performance of Bridge Members Retrofitted with Near-Surface-Mounted Carbon Fiber Reinforced Polymer Composites
32. MPC-428: Using Recycled Concrete Aggregate in New Concrete Construction
33. MPC-429: A Methodology for Developing a Replacement Strategy for County/City Owned Bridges
34. MPC-430: Implementation of Intelligent Compaction Technologies for Road Constructions in Wyoming
35. MPC-434: A Bicycle Network Analysis Tool for Planning Applications in Small Communities
36. MPC-437: Fiber Reinforced Concrete for Structure Component
37. MPC-439: Precast Bridge Girder Details for Improved Performance
38. MPC-440: Tolerances for Placement of Tie Bars in Portland Cement Concrete Pavements
39. MPC-441: Developing a Pavement Management System for Small Communities
40. MPC-442: Improving Rural Emergency Medical Services (EMS) through Transportation System Enhancements, Phase II
41. MPC-443: Bridge Structure Alternatives for Local Roads
42. MPC-444: Data-driven Freeway Performance Evaluation Framework for Project Prioritization and Decision Making
43. MPC-445: A Sensor Fusion Approach to Assess Pavement Condition and Maintenance Effectiveness

**Table 4: MPC Research Projects Most Directly Correlated with Economic Competitiveness**

1. MPC-354: Geotechnical Limit to Scour at Spill-through Abutments (Year 2)
2. MPC-364: Do Changing Prices Portend a Shift in Fuel Consumption, Diminished Greenhouse Gas Emissions, and Lower Fuel Tax Revenue?
3. MPC-366: Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks, Phase I – Instrumentation Development and Validation
4. MPC-375: Small Railroad Capital Investment Needs and Financial Options
5. MPC-379: Plastic-Aluminum Composites in Transportation Infrastructure
6. MPC-380: Investigation of Interactions Between Traffic Law Enforcement and Driving Behavior on Rural Highways in Colorado
7. MPC-381: Performance-based Interaction Analysis of Damage on Bridge Expansion Joints and Heavy Traffic
8. MPC-382: Seismic Behavior of Steel Bridges with Fatigue-prone Details
9. MPC-384: Understanding Public Perceptions of Different Revenue Generation Systems for Highway Construction and Maintenance
10. MPC-387: Comprehensive GIS-Based Rural Regional Transportation Planning Models
11. MPC-395: Accelerated Bridge Construction in South Dakota: Pilot Study for Implementation Strategy

12. MPC-396: Extent, Severity, and Location of Chip Seal Loss on the South Dakota State Road Network
13. MPC-397: Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
14. MPC-402: Seismic Performance of SCC Bridge Columns
15. MPC-408: Exploring Unique Plastic-Reinforced Bridge Decks: Phase I
16. MPC-418: 400 South Corridor Assessment
17. MPC-422: Highway Structures Supported on Expanded Polystyrene (EPS) Embankment without Deep Foundations
18. MPC-425: Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
19. MPC-426: Does the Livability of a Residential Street Depend on the Characteristics of the Neighboring Street Network?
20. MPC-427: Fire Performance of Bridge Members Retrofitted with Near-Surface-Mounted Carbon Fiber Reinforced Polymer Composites
21. MPC-433: Real-Time Traffic Management to Maximize Throughput of Automated Vehicles
22. MPC-435: Realization of a Coarse Position Verification System for an Automated Highway System
23. MPC-437: Fiber Reinforced Concrete for Structure Component
24. MPC-439: Precast Bridge Girder Details for Improved Performance
25. MPC-440: Tolerances for Placement of Tie Bars in Portland Cement Concrete Pavements
26. MPC-443: Bridge Structure Alternatives for Local Roads
27. MPC-445: A Sensor Fusion Approach to Assess Pavement Condition and Maintenance Effectiveness

**Table 5: MPC Research Projects Most Directly Correlated with Livable Communities**

1. MPC-361: Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit in Denver, Colorado
2. MPC-379: Plastic-Aluminum Composites in Transportation Infrastructure
3. MPC-380: Investigation of Interactions Between Traffic Law Enforcement and Driving Behavior on Rural Highways in Colorado
4. MPC-381: Performance-based Interaction Analysis of Damage on Bridge Expansion Joints and Heavy Traffic
5. MPC-387: Comprehensive GIS-Based Rural Regional Transportation Planning Models
6. MPC-392: Evaluation of Spliced Sleeve Connections for Precast Reinforced Concrete Bridge Piers
7. MPC-393: Traffic Modeling of Transit Oriented Development
8. MPC-408: Exploring Unique Plastic-Reinforced Bridge Decks: Phase I
9. MPC-417: Evaluation and Development of Livability and Sustainability Programs for Indian Reservations
10. MPC-418: 400 South Corridor Assessment
11. MPC-425: Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
12. MPC-426: Does the Livability of a Residential Street Depend on the Characteristics of the Neighboring Street Network?
13. MPC-436: Using Flocculation to Reduce Turbidity of Construction Site Runoff
14. MPC-438: Calibration of HSM Predictive Methods on Rural State and Local Highways
15. MPC-444: Data-driven Freeway Performance Evaluation Framework for Project Prioritization and Decision Making

**Table 6: MPC Research Projects Most Directly Correlated with Environmental Sustainability**

1. MPC-411: Re-Use of Mine Waste Materials Amended with Fly Ash in Transportation Earthwork Projects
2. MPC-414: Quantifying Sustainability Metrics for Trunkline Bridges in the Mountain Plains Region
3. MPC-416: Development and Testing of Crashworthy Ipe Bridge Rails
4. MPC-417: Evaluation and Development of Livability and Sustainability Programs for Indian Reservations
5. MPC-418: 400 South Corridor Assessment
6. MPC-421: Seismic Rehabilitation of Skewed and Curved Bridges Using a New Generation of Bulking Restrained Braces

7. MPC-428: Using Recycled Concrete Aggregate in New Concrete Construction
8. MPC-436: Using Flocculation to Reduce Turbidity of Construction Site Runoff
9. MPC-441: Developing a Pavement Management System for Small Communities
10. MPC-442: Improving Rural Emergency Medical Services (EMS) through Transportation System Enhancements, Phase II

**Table 7: MPC Education Projects**

1. MPC-385: Educational and Workforce Development Proposal: STEM Outreach at Colorado State University
2. MPC-403: Web-based Decision Support Tool for Traffic Management and Work Zone Analysis
3. MPC-424: Educational and Workforce Development Proposal: Ethics and Academic Conduct

**ii. Educational Accomplishments**

The transportation and transportation-related courses offered during Spring and Summer 2015 are listed in Table 8, organized by major subject area. In some cases, courses with the same titles were offered at more than one MPC university. In these cases, the number of courses offered is shown in parenthesis.

**Table 8: Transportation and Transportation-Related Courses Offered This Reporting Period**

Major Subject Area	Course Title
Engineering & Design	Advanced Concrete Design
	Advanced Geotechnical Testing and Lab
	Advanced Reinforced Concrete
	Advanced Steel Behavior and Design
	Advanced Street & Highway Design
	Bridge Engineering and Hazards
	Concrete Design II Undergraduate
	Concrete Science Graduate
	Design of Reinforced Concrete Structures
	Engineering Surveying
	Finite Element Method
	Geographic Information Systems for Civil Engineers
	Geometric Design of Highways
	Geotechnical Engineering and Lab
	GIS in Civil and Environmental Engineering
	Highway and Traffic Engineering
	Highway Bridge Engineering
	Highway Design Undergraduate
	Highway Engineering
	Hydraulic Engineering
	Infrastructure and Utility Management
	Introduction to Geotechnical Engineering
	Introduction to Transportation Engineering
	Materials and Lab
	Pavement Materials
	Slope Stability and Retaining Structures
	Soil Dynamics Graduate
Steel Design	

	Structural Analysis
	Sustainable Materials Undergraduate
<b>Freight &amp; Logistics</b>	Case Studies in Logistics
	Freight Transportation Systems
	International Logistics Management
	Modeling for Transportation and Logistics Decision Analysis
	Transportation Logistics
<b>Planning &amp; Environment</b>	Context Sensitive Solutions
	Enterprise Resource Planning
	Form and Formation of Cities
	Natural and Built Environments
	Planning for Healthy Communities
	Quantitative Tools for Transportation Management
	Spatial Analysis in Transportation
	Transportation and Land Use
	Transportation Law and Regulation: Domestic and International
	Transportation Management, Leadership, and Values
	Transportation Planning Undergraduate
	Urban Development
<b>Traffic &amp; Operations</b>	Traffic Impact Assessment
	Transportation Engineering Undergraduate
<b>Transportation Safety</b>	Traffic and Safety Data Analysis
	Transportation Safety
<b>Transportation Systems</b>	Freight Transportation Systems
	Infrastructure and Transportation Systems
	Intermodal Transportation Systems
	Statistical and Econometric Analysis Graduate
	Sustainable Transportation Systems
	Transportation Systems II
	Transportation Systems Lab
<b>Public Transportation</b>	Passenger Transportation Systems
	Public Transportation
	Public Transportation II

Altogether, 61 transportation and transportation-related courses have been offered during this reporting period. Altogether, 375 transportation courses have been offered during the grant period thus far. In addition to the courses listed in Table 8, foundational courses in engineering materials, mechanics, structural analysis, and geotechnical engineering have been offered at most of the MPC universities.

### iii. Workforce Development Accomplishments

**Training** events provided for transportation professionals during this reporting period are listed below.

1. 2015 Oil & Gas Producing Counties
2. 3-State Roundtable - Construction Survey & Grade Control
3. 3-State Roundtable - Environmental Process (*CLOSED VC - NOT ON LMS*)
4. 7 Mindsets for Success & Team Building
5. Access Management Training
6. ADA

7. ADA Designing, Constructing, & Maintaining Pedestrian Facilities in the Public Right-Of-Way
8. Asphalt Crack Sealing
9. ATSSA Flagger Certification
10. ATSSA Traffic Control Technician (TCT)
11. Basic Concepts of Pavement Preservation
12. Basic Sign Installation & Maintenance Training
13. Basic Surveying
14. Basic Surveying / Grade Checking
15. Basics of a Good Road
16. Cement Seminar
17. Conflict Management: The Not So Merry-Go-Round of Conflict
18. Construction Project Management/Contract Administration
19. Deciding How to Decide
20. Delivering Leading Edge Customer Service
21. EDC Exchange
22. Full-Depth Reclamation/Cement Stabilization
23. Fundamentals of PROW ADA Ramp Design, Layout, Inspection and Construction
24. Future Directions in Highway and Street Design and Analysis
25. Gravel Road Maintenance
26. Gravel Roads Academy
27. Guardrail Installation & Inspection
28. Heavy Equipment Operations
29. Heavy Equipment Safety Operations
30. Highway Pipe Installation
31. Highway Pipe Installation - Construction and Inspection
32. Integrated Roadside Vegetation Management
33. Intermodal Transportation Systems
34. Landslides - Slope Stability, Hydrology, Analysis, Repair & Inspection
35. Leading a Successful Change Effort
36. Legal Aspects of Traffic Control on Construction Projects
37. Legal Aspects of Traffic Control on Construction Projects (Tort Liability)
38. Managing Organizational Communication
39. Motor Grader Operator Training
40. ND Asphalt Conference
41. ND Construction Project Management Cert Training
42. OSHA 10 Hr. - Specifically for the Roadway Construction Industry
43. Pavement Markings for Maintenance Employees
44. PCC Joint Sealing & Resealing Methods
45. PE Review for Civil Engineers
46. Performance-Based Analysis of Geometric Design of Highways and Streets
47. Presentation for Power, Persuasion and Purpose
48. Preventing Runovers & Backovers & Roadway Safety
49. Registered Stormwater Inspector
50. Registered SWPPP Reviewer
51. Roadway Drainage
52. Seal Coat Workshop
53. Sign Truck
54. State of the Guardrail Industry
55. Street Lighting
56. Tree Trimming
57. Trenching and Shoring



- 58. Truck Weight Education Workshop
- 59. Using the Right Tools for Systemic Safety Analysis
- 60. Utah Career Days
- 61. Western Counties Sign Truck
- 62. Winter Road Maintenance
- 63. Workforce Development
- 64. Workplace, Equipment & Jobsite Safety
- 65. Workzone Training
- 66. WYDOT Certification in Aggregate, Asphalt, and Concrete
- 67. Wyoming Transportation and Safety Congress

**iv. Research accomplishments**

The following peer reviewed research reports/presentations were published during the period of January – June 2015 from grant DTRT12-G-UTC08 or previous grants.

Project #	Title	Date	Report No.
364	Do Changing Prices Portend a Shift in Fuel Consumption, Diminished Greenhouse Gas Emissions, and Lower Fuel Tax Revenue?	January 2015	MPC-278
361	Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit in Denver, Colorado	March 2015	MPC-279
354	Geotechnical Limit to Scour at Spill-through Bridge Abutments: Laboratory Investigation	March 2015	MPC-280
430	Implementation of Intelligent Compaction Technologies for Road Constructions in Wyoming	March 2015	MPC-281
374	An Integrated Real-Time Health Monitoring and Impact/Collision Detection System for Bridges in Cold Remote Regions	March 2015	MPC-282
433	Real-Time Traffic Management to Maximize Throughput of Automated Vehicles	March 2015	MPC-283
435	Position Verification Systems for an Automated Highway System	March 2015	MPC-284
434	A Bicycle Network Analysis Tool for Planning Applications in Small Communities	May 2015	MPC-285

**c. How have the results been disseminated?**

The results are being disseminated in a variety of ways, including: (1) workshops and conferences, (2) videoconferences, (3) online modules, (4) presentations at conferences, (5) publications, (6) webpage postings and displays, and (7) Internet-based dissemination media, including broadcast emails and webinars. These accomplishments are summarized under the products section of this report.

**d. What do you plan to do during the next reporting period to accomplish the goals/objectives?**

(1) Continue to offer the multidisciplinary multimodal catalogue of courses described in the prospectus and teach those courses scheduled during the academic year (2) Continue to deliver extensive programs of technical training, similar to the programs illustrated in b.iii. (3) With the guidance of the recently established North Dakota Transportation Safety Advisory Group, identify a two-year work plan to conduct safety research and technical training that addresses key Bakken-related issues, including motor carrier, railway, and pipeline safety.

(4) In conjunction with tribal partners, develop a two-year plan for tribal transportation research and technical assistance to include: a) the development of an emergency management/response guidebook, b) GIS modeling and technical assistance in traffic forecasting; and c) help in implementing road safety procedures and countermeasures on tribal roads. (5) Continue the strong MPC research programs, which will result in many new publications and journal papers. (6) Participate in conferences and workshops on transportation and energy development. (7) Collaborate with other UTCs to promote greater exchange of information and explore partnering possibilities in railway and waterway transportation. (9) Continue to involve graduate students in MPC research projects.

## **2. Products: What has the program produced?**

### **a. Publications, conference papers, presentations**

#### **i. Participation in key conferences and workshops**

- 2015 ASCE Structures Congress, Portland, OR
- 4th International Conference on Material Modeling, Berkley, CA, USA
- 55th Annual Meeting of the ITE Intermountain Section, Jackson, WY
- 5th International Symposium on Highway Geometric Design, Vancouver, Canada
- American Concrete Institute's Spring 2015 Convention, Kansas City, MO
- American Society of Civil Engineers: EWRI Conference, Austin, TX, May 18-22
- Annual Meeting of the Society for Personality and Social Psychology, Long Beach, CA
- Concrete Spring Symposium, Utah State Capitol Building, Salt Lake City, UT
- Highway Safety Performance/Safety Data, Analysis and Evaluation (ANB25/ANB20) Joint Midyear Meeting, June 10-12, Irvine, CA
- Intelligent Compaction Data Management, 2-day Workshop at University of Wyoming, Laramie, WY
- Meeting of AASHTO's Subcommittee on Seismic Design of Bridges, Saratoga Springs, NY
- Meeting of the ASCE Engineering Mechanics Institute, Stanford University
- ND EPSCoR 2015 State Conference, Fargo, ND, April 2015
- Transportation Research Board (TRB) 94<sup>th</sup> Annual Meeting, Washington, D.C., January 2015
- Transportation Research Board, Low Volume Roads Conference, 2015
- UDOT Research Conference, Salt Lake City, UT
- Utah Department of Transportation Research Workshop (UTRAC), Sandy, Utah
- Western South Dakota Hydrology Meeting, Rapid City, April 15, 2015
- Workshop on Future Directions in Highway and Street Design and Analysis, Vancouver, Canada

#### **ii. Key Journal Articles or Conference Publications**

- Ameli, M.J., Brown, D.N., Parks, J.E., and Pantelides, C.P. Seismic column-to-footing connections using grouted splice sleeves. *ACI Structural Journal*, submitted. (yes)
- Ameli, M.J., Parks, J.E., Brown, D.N., and Pantelides, C.P. Seismic evaluation of grouted splice sleeve connections for reinforced precast concrete column-to-cap beam joints in accelerated bridge construction. *PCI Journal*, 60(2), 80-103, 2015. (yes)
- Chen, Feng, Ma, Xiaoxiang and Chen, Suren (2014). "Refined-scale panel data crash rate analysis using random-effects tobit model", *Accident Analysis and Prevention*, 2014 Sep 27;73C:323-332.
- Chen, J. Y.; Pan, E.; Heyliger, P. R. Static deformation of a spherically anisotropic and multilayered magneto-electro-elastic hollow sphere. *INTERNATIONAL JOURNAL OF SOLIDS AND STRUCTURES* Volume: 60-61 Pages: 66-74 Published: MAY 15, 2015.
- Ettema, R., Ng, K., Chakradhar, R. and Kempema, E. (2015), "Failure of Spill-through Bridge Abutments during Scour: Flume and Field Observations." *ASCE Journal of Hydraulic Engineering*,

doi.org/10.1061/(ASCE)HY.1943-7900.0000996.

- Gorakhki R. H. M. and Bareither, C. A. (2016). Effects of salinity on the geotechnical characterization of fine-grained soils and mine tailings, *Geotechnical Testing Journal*, 39(1). Accepted.
- Kim, M.O. and Bordelon, A. Determination of total fracture energy for fiber-reinforced concrete, *American Concrete Institute Special Publication-300CD: (CD-ROM) Fracture Mechanics Applications in Concrete*, Editors: C. Gaedicke and A. Bordelon, ACI Committee 446, Farmington Hills, MI, 2015. (no)
- Kim, Y.J. and Namrou, A. Interface between near-surface-mounted CFRP-concrete interface in thermal distress *ACI Structural Journal*, American Concrete Institute (ACI) (submission number-S-2014-241: accepted)
- Ma, Xiaoxiang, Chen, Feng and Chen, Suren (2015). “Empirical Analysis of Crash Injury Severity on Mountainous and Non-Mountainous Interstate Highways”, *Traffic Injury Prevention* (accepted)
- Namrou, A. and Kim, Y.J. Residual performance of concrete-adhesive interface at elevated temperatures, *Construction and Building Materials*, Elsevier (submission number-CONBUILDMAT-D-01266: submitted)
- Parks, J.E., Brown, D.N., Ameli, M.J., and Pantelides, C.P. Seismic repair of severely damaged precast bridge columns. *ACI Structural Journal*, submitted. (yes)
- Pei, Shiling, Nadim Wehbe, and Brittney Kelley: Experimental study on river ice loads in South Dakota. Technical note submitted to *Journal of Cold Regions Engineering* (under review), MPC support is acknowledged.
- Qin, Xiao, Zhao Shen, and Nadim Wehbe: Analyzing Collision Risk between Trucks and Interstate Overpasses, *Journal of Transportation Engineering* (under review), MPC support is acknowledged.
- Ryu, Seungkyu, Anthony Chen, and Keechoo Choi. A two-stage bicycle traffic assignment model. *Journal of Advanced Transportation* (submitted), 2015, acknowledgement of federal support (yes)
- Ryu, Seungkyu, Jacqueline Su, and Anthony Chen. A Bicycle Network Analysis Tool for Planning Applications in Small Communities. MPC 15-285, North Dakota State University - Upper Great Plains Transportation Institute, Fargo: Mountain-Plains Consortium, 2015.
- Saboori, A., Yazdani, S., and Tolliver D. (accepted). “Anisotropic Damage Mechanics Modeling of Concrete under Biaxial Fatigue Loading”. *Open Journal of Civil Engineering*. ASEA-SEC-2 Proceedings (pp. 251-256). ISEC Press.
- Saboori, A., Yazdani, S., Reberg, A., and Tolliver, D. (2014, August). “Anisotropic Damage Modeling of Concrete Subjected to Freeze-Thaw Process”. *International Journal of Civil and Structural Engineering*, 5(1), 42-51.
- Sanbonmatsu, D. M., Strayer, D. L., Behrends, A. A., Medeiros Ward, N., and Watson, J. M. Why drivers use cell phones and why they support legislation to restrict this practice. *PLOS ONE*, submitted. (yes)
- Sanbonmatsu, D. M., Strayer, D. L., Biondi, F., Behrends, A. A., and Moore, S. M. Cell phone use diminishes self-awareness of impaired driving. *Psychonomic Bulletin and Review*, submitted (yes)
- Savan, C.M., Ng, K.W., and Ksaibati, K. “Benefit-Cost Analysis and Application of Intelligent Compaction.” *Road and Transport Research Journal*, ARRB Group. (Submitted in 2015)
- Shea, M.S., Le, T.Q., and Porter, R.J. A combined crash frequency-crash severity evaluation of geometric design decisions: entrance-exit ramp spacing and auxiliary lane presence,” *Transportation Research Record: Journal of the Transportation Research Board*, accepted. (yes)
- Shinstine, D.; Denzer, A.; and Ksaibati, K.; “Livability and Transportation on Indian Reservations” *Journal of Rural and Community Development*, 2015.
- Siriwardanage, T. and Kim, Y.J. Thermomechanical behavior of NSM CFRP-concrete interface, *ACI Structural Journal*, American Concrete Institute (ACI) (submission number-S-2015-027: accepted)
- Sobieck, T, Atadero, R., and Mahmoud, H. (2014) “Fatigue Crack Propagation of Notched Steel Rebar in RC Beams Repaired with Externally Bonded CFRP”, *ASCE Journal of Composites for Construction*, DOI: 10.1061/(ASCE)CC.1943-5614.0000541.
- Soltani-Sobh, A. Heaslip, K., Bosworth, R., \*Barnes, R. (Accepted). Effect of Improving Vehicle Fuel Efficiency on Fuel Tax Revenue and Greenhouse Gas Emissions. Accepted to *Transportation Research Record: Journal of the Transportation Research Board*.

- Tasic, I., Zlatkovic, M., Martin, P.T., and Porter, R.J. Street connectivity versus street widening: enhanced street connectivity on traffic operations in transit-supportive environments, *Transportation Research Record: Journal of the Transportation Research Board*, accepted. (yes)
- Taylor, J., Zhou, X., Roupail, N.M., and Porter, R.J. "Method for investigating intradriver heterogeneity using vehicle trajectory data: a dynamic time warping approach," In *Transportation Research Part B 73*, 2015, pp. 59-80. (no)
- Tucker, C. and Ibarra, L. Effects of partial design strength concrete on the seismic performance of concrete-filled tube columns in accelerated bridge construction. *ASCE Journal of Bridge Engineering*, accepted. (yes)
- Wehbe, Nadim and Walker Olson: Experimental Evaluation Of Misaligned Tie Bar Effects On PCC Pavement Longitudinal Joints, *The Eighth International Structural Engineering and Construction Conference Sydney, Australia* (accepted), MPC support is acknowledged
- Z. Zhang, Y. Huang, R. Bridgelall, L. Palek, and R. Strommen, "Sampling Optimization for High-speed Weigh-in-Motion Measurements Using In-pavement Strain Based Sensors", *Measurement Science and Technology*, 26, 065003, 2015.
- Zlatkovic, M., Porter, R.J., and Kergaye, C. Performance-based pavement marking warranty contracts: experience and lessons learned in the State of Utah," *Transportation Research Record: Journal of the Transportation Research Board*, accepted. (no)

### iii. Key Conference Papers

- Behrends, A.A., Sanbonmatus, D.M., Strayer, D.L., Biondi, F., & Moore, S.M.. "Cell Phone Use Diminishes Self-Awareness of the Adverse Effects of Cell Phone Use on Driving," Annual meeting of the Society for Personality and Social Psychology, Long Beach, CA, 2015.
- Henao, A. and Marshall, W. "Fuel Price Shocks, Affordability, and Transportation Economic Resilience." *Transportation Research Board*, Washington, D.C., January 2015.
- Kim, M.O., Bordelon, A. "Numerical Study on the Cracking Behavior of Fiber Reinforced Concrete Overlay Subjected to Temperature Loading", *ASCE Cold Regions Engineering Conference July 19-22, 2015 Salt Lake City, UT*. (submitted)
- Ma, Xiaoxiang, Chen, Feng and Chen, Suren (2015). "Empirical Analysis of Driver-Injury Severity on Mountainous and Non-Mountainous Interstate Highways: A Comparative Study", 94th TRB annual conference, Jan 11-15, 2015.
- Ma, Xiaoxiang, Chen, Feng and Chen, Suren (2015). "Modeling crash rates for a mountainous highway using refined-scale panel data", 94th TRB annual conference, Jan 11-15, 2015.
- Marshall, W. and Henao, A. "The Shock Heard 'Round the Suburbs: Assessing Vulnerability, Resilience, and Transportation Affordability of Higher Fuel Price Scenarios for the Denver Metropolitan Region." *Transportation Research Board*, Washington, D.C., January 2015.
- Miller, P. and Mahmoud, H. (2015) "Distortion-Induced Fatigue Crack Growth", *ASCE Journal of Bridge Engineering*, DOI: 10.1061/(ASCE)BE.1943-5592.0000793 , 04015041.
- Musunuru, A, Porter, R.J., Fyfe, M., and Sayed, T. "Risk and Reliability Analysis of Geometric Design Criteria: A Critical Synthesis," *Compendium of Papers from the 5th International Symposium on Highway Geometric Design*, Vancouver, Canada, June 22-24, 2015.
- Ng, K., Chakrahda, R., Ettema, R. and Kempema, E. (2014), "Laboratory Investigation of Embankment Soil Strength Influence on Abutment Scour: Early Findings." *ASCE-EWRI Conference*, Austin, Texas, May 18 - 23.
- Ozbek, M. E., Albeiruti, N., and Atadero, R. (2015). "Understanding Public Perceptions of Different Revenue Generation Systems for Highway Construction and Maintenance." In: *Proceedings of the 2015 TRB 94th Annual Conference*, 16 pages (Electronic Proceedings with no page numbers), January 11-15, Washington D.C.
- Ryu, Seungkyu, Anthony Chen, and Keechoo Choi. "A two-stage bicycle traffic assignment model." *Proceedings of the 94th Transportation Research Board Annual Meeting*, Washington DC. 2015.

- Saboori, A., Yazdani, S., Reberg, A., Yang, M., Tolliver, D., and Mamani, S. (2014). "Modeling of Concrete Behavior under Biaxial Fatigue Loading with Various Mean Stresses". ASEA-SEC-2 Proceedings (pp. 51-56). ISEC Press.
- Saboori, A., Yazdani, S., Reberg, A., Yang, M., Tolliver, D., and Mamani, S. (2014). "Modeling Freeze and Thaw Damage in Concrete Decks using Damage Mechanics
- Savan, C., Ng, K.W., and Ksaibati, K. "Intelligent Compaction for roadway Construction and Quality Assurance." Proceedings of the 65th Annual Highway Geology Symposium, Laramie, WY, 2014, pp. 1-19.
- Shea, M.S., Le, T.Q., and Porter, R.J. "A Combined Crash Frequency-Crash Severity Evaluation of Geometric Design Decisions: Entrance-Exit Ramp Spacing and Auxiliary Lane Presence," Compendium of Papers from the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 11-15, 2015.
- Tasic, I. and Porter, R.J. "Modeling Spatial Relationships between Access to Multimodal Transportation and Traffic Safety Outcomes," Compendium of Papers from the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 11-15, 2015.
- Tasic, I., Zlatkovic, M., Martin, P.T., and Porter, R.J. "Street Connectivity versus Street Widening: Enhanced Street Connectivity on Traffic Operations in Transit-Supportive Environments," Compendium of Papers from the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 11-15, 2015.
- Zlatkovic, M., Porter, R.J., and Kergaye, C. "Performance-Based Pavement Marking Warranty Contracts: Experience and Lessons Learned in the State of Utah," Compendium of Papers from the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 11-15, 2015.

#### iv. Key Presentations

- Bordelon, A.C., Hiller, J.E., Roesler, J.R. and Cervantes, V.G. "Investigation of ESALs versus Load Spectra for Rigid Pavement Design" 2015 Airfield and Highway Pavement Conference, June 7-10, 2015 in Miami, FL.
- Chen, Z. and Liu, X. "Empirical Analysis for Quantifying the Freeway Incident-Induced Delay." 2014 UDOT Research Conference, Salt Lake City, UT, October 29th, 2014.
- Choi, J. and Lee, E. "Reshaping Tribal Road Network Using Public Information." 2015 Transportation Research Board Annual Meeting in Washington D.C. January 11-15, 2015
- Henao, A. and Marshall, W. "Fuel Price Shocks, Affordability, and Transportation Economic Resilience." Transportation Research Board, Washington, D.C., January 2015.
- Humburg, Jacob, and Hua, Guanghui. "Factors Affecting Flocculation of Turbidity in Construction Site Runoff Using Polyacrylamide." Western South Dakota Hydrology Meeting, Rapid City, April 15, 2015. Poster Presentation.
- Marshall, W. and Henao, A. "The Shock Heard 'Round the Suburbs: Assessing Vulnerability, Resilience, and Transportation Affordability of Higher Fuel Price Scenarios for the Denver Metropolitan Region." Transportation Research Board, Washington, D.C., January 2015.
- MPC-442: Improving Rural Emergency Medical Services (EMS) through Transportation System Enhancements, Phase II, Presentation at the South Dakota EMS Annual conference
- Musunuru, A, Porter, R.J., Fyfe, M., and Sayed, T. "Risk and Reliability Analysis of Geometric Design Criteria: A Critical Synthesis," Poster Session 2 of the 5th International Symposium on Highway Geometric Design, Vancouver, Canada, June 23, 2015.
- Ng, K., Chakrahda, R., Ettema, R. and Kempema, E. (2014), "Laboratory Investigation of Embankment Soil Strength Influence on Abutment Scour: Early Findings." ASCE-EWRI Conference, Austin, Texas, May 18 - 23.
- Pantelides, C. "Seismic Evaluation of Grouted Splice Sleeve Connections for Reinforced Precast Concrete Bridge Piers." AASHTO - T3 Subcommittee on Seismic Design of Bridges, Saratoga Springs, NY, April 2015.
- Porter, R.J. "Past, Current, and Future Roles of Speed in Highway and Street Design,"

Workshop 2 of the 5th International Symposium on Highway Geometric Design, Vancouver, Canada, June 21, 2015.

- Porter, R.J. “Performance-Based Geometric Design Analysis,” Workshop 2 of the 5th International Symposium on Highway Geometric Design, Vancouver, Canada, June 21, 2015.
- Porter, R.J. “The Art of Urban Street Performance Metrics: Safety Metrics for Decision Making,” Session 105 of the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 11, 2015.
- Porter, R.J. “The Present and Future of Speed Limits in a Toward Zero Deaths Framework: Speed Concepts, Speed Limits, and the Effects of the Road Environment on Speed and Safety,” Session 178 of the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 11, 2015.
- Qin, X. "Calibrating HSM for South Dakota Rural Highways", Highway Safety Performance (ANB25), Safety Data, Analysis and Evaluation (ANB20), and AASHTO Joint Midyear Meeting, June 10-12, Irvine, CA.
- Ryu, Seungkyu, Anthony Chen, and Keechoo Choi. "A two-stage bicycle traffic assignment model." 94th Transportation Research Board Annual Meeting, Washington DC, January 11-15, 2015.
- Savan, C., Ng, K.W., and Ksaibati, K. “Intelligent Compaction for roadway Construction and Quality Assurance.” The 65th Annual Highway Geology Symposium, Laramie, WY, 2014.
- Shea, M.S., Le, T.Q., and Porter, R.J. “A Combined Crash Frequency-Crash Severity Evaluation of Geometric Design Decisions: Entrance-Exit Ramp Spacing and Auxiliary Lane Presence,” Session 766 of the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 14, 2015.
- Sherry, P. (2015) Leadership in Intermodal Transportation. A presentation delivered to the annual meeting of the Denver Transportation Club. January, 2015.
- Sherry, P. (2015). Improving Safety of Commuter Rail Operations. Presented to the Chicago Transit Authority. June, 2015.
- Siriwardanage, T. and Kim, Y.J. 2015. Thermal-conduction modeling of a composite material embedded in a concrete substrate, 4th International Conference on Material Modeling, Berkley, CA, USA
- Stevanovic, A., M. Zlatkovic, J. Stevanovic, C. Kergaye, M. Ostojic, and I. Tasic. “Multimodal Traffic Control for Large Urban Networks with Special Priority for Light Rail Transit.” Transportation Research Board 94th Annual Meeting, Washington, D.C., January 11-15, 2015.
- Tasic, I. "Traffic Modeling of Transit Oriented Development: Intersection Design, Street Connectivity, Traffic Calming Measures, and Accessibility Issues." ITE Intermountain Section 55th Annual Meeting, Jackson, WY, May 14-16, 2015.
- Tasic, I. and Porter, R.J. “Modeling Spatial Relationships between Access to Multimodal Transportation and Traffic Safety Outcomes,” Session 540 of the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 13, 2015.
- Tasic, I., Zlatkovic, M., Martin, P.T., and Porter, R.J. “Street Connectivity Versus Street Widening: Enhanced Street Connectivity on Traffic Operations in Transit-Supportive Environments,” Session 674 of the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 13, 2015.
- Wang, Y. and Ibarra, L. “Performance-based assessment of a reinforced concrete bridge with buckling restrained braces,” ASCE Engineering Mechanics Institute, Stanford University, 2015.
- Z. Zhang & Y. Huang, “Structural Health Monitoring for Concrete Overlay”, ND EPSCoR 2015 State Conference, Fargo, ND, April 2015
- Zlatkovic, M., A. Stevanovic, I. Tasic, and M. Ostojic. “Multimodal Corridors Assessment with Transit Priority Enhancements: Case Study of the Future Airport Light Rail Line in Salt Lake City.” Transportation Research Board 94th Annual Meeting, Washington, D.C., January 11-15,

2015.

- Zlatkovic, M., Porter, R.J., and Kergaye, C. “Performance-Based Pavement Marking Warranty Contracts: Experience and Lessons Learned in the State of Utah,” Session 239 of the 94th Annual Meeting of the Transportation Research Board, Washington, D.C., January 12, 2015.

**b. Books or other non-periodical, one-time publications**

- MPC-378: MEMS Sensors for Transportation Structures, Colorado State University. An additional journal article is nearly completed for submission to JASA.

**c. Website(s) or other internet site(s)**

Nothing to report at this time.

**d. Technologies or Techniques**

Nothing to report at this time.

**e. Inventions, patent applications, and/or licenses?**

Nothing to report at this time.

**f. Other**

- MPC-375: Small Railroad Capital Investment Needs and Financial Options, North Dakota State University. Progress on Eileen Campbell's Dissertation.
- MPC-442: Improving Rural Emergency Medical Services (EMS) through Transportation System Enhancements, Phase II, North Dakota State University. A proposal was submitted to the Department of Public Safety/Department of Health to perform similar analysis on the cardiac care data for the state of SD.
- MPC-361: Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit in Denver, Colorado. University of Colorado Denver. Marshall, W., Henao, A., and Bronson, R. Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit in Denver, Colorado. Mountain Plains Consortium, 2015.
- MPC-426: Does the Livability of a Residential Street Depend on the Characteristics of the Neighboring Street Network? University of Colorado Denver. This project has informed the design, creation, and adoption of a TRB Task Force on urban arterials and health.
- MPC-354: Geotechnical Limit to Scour at Spill-through Abutments (Year 2), University of Wyoming. An NCHRP Problem Statement: “Scour At Spill-Through Bridge Abutments – A Case For Hydraulic And Geotechnical Collaboration On Failure Modes And Countermeasures”
- MPC-430: Implementation of Intelligent Compaction Technologies for Road Constructions in Wyoming, University of Wyoming. Savan, C. (2014). Intelligent Compaction for Roadway Soil and Asphalt Pavement. Master Thesis, Department of Civil and Architectural Engineering, University of Wyoming, Laramie, WY.

**3. Participants and Other Collaborating Organizations: Who has been involved?**

**a. What individuals have worked on the program?**

The principal investigators, faculty, and administrators participating in MPC project:

Six principal investigators, faculty, and administrators participating in MPC projects at **Utah State University** are:

Paul Barr, University Program Coordinator, PI, and collaborator; Ryan Bosworth, Co-PI; Michael Thomas, Investigator; Thidapat (Tam) Chantem, PI; Anthony Chen, PI; and Ryan Gerdes, PI. In addition, ten students are participating in MPC research projects at **Utah State University**: Doctorate Students – Seunkyu Ryu, Ali Soltani Sobh, Donghyung Yook, Ryan Barnes, Ruchir Chauhan; Masters Students – Divya Desiraju, Niranjana Chandrappa; Undergraduate Students – Eric Meissner, Jaque Johansen, and Jacqueline Su.

Nine principal investigators, faculty, and administrators participating in MPC projects at the **University of Wyoming** are: Khaled Ksaibati, University Program Coordinator, PI, and Co-PI; Robert Ettema, PI; Rhonda Young, PI; Richard J. Schmidt, PI; Kam Ng Co-PI and PI; Jennifer Tanner, PI; Debbie Shinstine, Post Doctorate; Ed Kempema, Lab Director; and James Branscomb, Engineer. Fourteen students participating in MPC research projects at the **University of Wyoming**: Doctorate Students: Edward Offei, Vijay Sabawat, Promoths Saha; Masters Students - Ram Chakradha, McKenzie Danforth, Darby Hacker, Rebecca Franke, Sanjay Pokharel, Bryce Fiore, Christopher Savan, Wesley Werbelow; Undergraduate Students - Chris Leclerc, and Britton Hammit. Others who participated in the projects at the **University of Wyoming**: Wendy Perkins, Administrator; Shaun Wulff, Statistics Professor; David Reynaud, NCHRP; Bart Bergendahl, FHWA; Larry Arneson, FHWA; WACERS; WCCA; and WYDOT.

Sixteen principal investigators, faculty, and administrators participating in MPC projects at the **University of Utah**: Richard J. Porter, University Program Coordinator and PI; David Sanbonmatsu, Co-PI; Peter Martin, PI; Chris P. Pantelides, PI; Lawrence D. Reaveley, Co-PI; Xuesong Zhou, PI; David Strayer, PI; Luis Ibara, PI and Co-PI; Evert Lawton, Co-PI; Cathy Liu, PI; Milan Zlatkovic, Principal Author and PI; Muhammad Farhan, Co-PI; Amanda Bordelon, PI; Jinjin Tang, Researcher and Visiting Professor; Jan Vaslestad Co-PI; and Steven Bartlett, PI. Eighteen graduate students are working on MPC research projects at the **University of Utah**: Doctorate Students – M.J. Ameli, Ivana Tasic, Tie Shi (visiting student), Jeffrey Taylor, Min Ook Kim, M. Scott Shea, Yuandong Wang, Anusha Musunuru, Arwen Behrends, Ramesh Neupane, Shannon Moore, and Zhuo Chen; Masters Students - Joel Parks, Dylan Brown, Catherine Tucker, Zachary Gibbs, and Anurag Upadhyay; Francesco Biondi, visiting student scholar.

Thirteen principal investigators, faculty, and administrators are participating in MPC projects at **South Dakota State University**: Nadim Wehbe, University Program Coordinator, PI, and Co-PI; Allen Jones, PI; Xiao Qin, PI and Co-PI; Guanghui Hua, PI; Haifa Samra, PI; Shiling Pei, PI; Daris Ormesher, Project Manager; Beverly Klein, Lab Staff; Dave Huft, Project Manager; Junwon Seo, Co-PI; Hao Wang, Subcontractor; Chad A. Comes, PE, Project Manager; and Aaron Breyfogle, Project Manager. In addition, fifteen graduate and undergraduate students are working on MPC research projects at **South Dakota State University**: Masters Students - Zhao Shen, Zhaoxiang He, Jacob Humburg, Micah Underberg, Michael Konrad, Walker Olson, Kofi Oppong, Brett Tigges, Brittney Ahrenstorff, Todd Pauly, Zhi Chen, Md. Razaur Shaon, Nicole Campbell, Melissa Tracy, and Abdullah Boudaqa.

Nine principal investigators, faculty, and administrators are participating in selected projects from **Colorado State University**: Rebecca Atadero, University Program Coordinator and PI; Paul Heyliger, PI; Suren Chen, PI; Hussam Mahmoud, PI; Mehmet Ozbek, PI; John van de Lindt, PI; Christopher Bareither, PI; Bolivar A. Senior, Co-PI; and Ward Johnson, NIST and Collaborator. In addition, sixteen graduate and undergraduate students are working on MPC research projects at **Colorado State University**: Doctorate Students- Xiaoxiang Ma, Kristen Peterson, Luke Chen, Akshat Chulahwat, Mehrdad Memari, Huajie Wen, and Mohammad Reza Hassanzadeh Gorakhki; Masters Students –Patrick Sanders, Chris Bright, Sultan Abdulaziz Alhomair, Tyler Sobieck, Vaishak Gopi, Nasser Alberuti, Paula Miller, Thomas Wilson, and Robert Lankford.

Altogether, nine principal investigators, faculty, and administrators are participating in selected projects at **North Dakota State University**: Kimberly Vachal, University Program Coordinator and PI; Dr. Frank Yazdani, PI; Doug Benson, PI; EunSu Lee, Co-PI and PI; Pan Lu, PI; Alan Dybing, Co-PI; Raj Bridgelall, PI; Ying Huang, Co-PI; Denver Tolliver, Director and Co-PI. In addition, eight graduate students are working on MPC projects at **North Dakota State University**: Doctorate Students- Poyraz Kayabas, Anne Campbell, Elvis Ndembe, Chijioke Ifepe, and



Zhiming Zhang; Masters Students- Ashkan Saboori, Sara Mamani, and Liuqing Hu.

One principal investigator, faculty, and administrator participating in MPC projects at the **University of Denver** include Patrick Sherry, University Program Coordinator and PI. Four graduate and undergraduate students working on MPC projects at **University of Denver** include: Doctoral Students - Keaton Zucker and Jessica Mantia; Masters Students- Rachel Mulholland and Wesley Pruitt.

Four principal investigators, faculty, and administrators participating in MPC projects at the **University of Colorado Denver** include: Wesley Marshall, University Program Coordinator and PI; Jimmy Kim, PI; Carolyn McAndrews, PI; and Bruce Janson, Faculty. Seventeen graduate and undergraduate students working on MPC projects at **University of Colorado Denver** include: Masters Students - Alejandro Henao, Rachael Bronson, Mahdi Alavizadeh, Greg Colucci, Zachary Henry, Mayam Karimi, Jenny McGinnis, Abdulaziz Alqurashi, Sarah Rosenberg, Tong Wen, Shile Dong, Thushara Siriwardanage, Laia Mitchell, and Craig Fisher; Undergraduate Students- Ben Johnk and Mat Tostle.

**b. What other organizations have been involved as partners?**

The timing of match funding and the commitments of collaborators vary widely throughout the life of the grant. During this period, we have the following committed collaborators.

1. AAA Foundation for Traffic Safety
2. AAR John Gray, Frank Hardesty, Shannon Stare
3. Ajou University, Korea
4. ASLRRRA Scott Sullivan, Elizabeth Petty, Richard Timmons
5. Association of General Contractors of South Dakota
6. City and County of Denver
7. City of Salt Lake Transportation Division
8. Colorado Department of Transportation
9. Denver Regional Council of Governments
10. Federal Highway Administration (FHWA)
11. Florida Atlantic University
12. Fort Berthold Reservation
13. FRA Administrators
14. Kittelson & Associates, Inc.
15. Minnesota Department of Transportation
16. MnROAD research facility
17. National Cooperative Highway Research Program
18. National Institute of Standards and Technology, Boulder
19. NCAR
20. North Dakota Department of Transportation
21. Northern Plain TTAP Center
22. Norwegian Public Roads Administration
23. Regional Transportation District
24. South Dakota Department of Transportation
25. South Dakota Office of EMS
26. Tailings and Mine Waste (TMW) Conference Committee
27. Tarek Sayed, University of British Columbia
28. Tegracore, Industrial partner
29. Tom Streicher, Vice President, American Short Line Railroad Association

30. University of Utah Department of City and Metropolitan Planning
31. Utah Department of Transportation
32. Utah Transit Authority
33. WACERS
34. Wasatch Front Regional Council
35. Wind River Indian Reservation
36. Wyoming Department of Transportation
37. Wyoming Division of FHWA

**c. Have other collaborators or contacts been involved?**

The list of collaborating organizations in 3(b) is complete, as of this grant period.

**4. Impact**

The impacts of the program will become clearer in future years. The implementation of research findings often lags project selection and completion. However, certain impacts are emerging. The benefits of the program are already being felt in many respects.

**1. Graduate Education.** Collectively, the MPC universities offer one of the most diverse and comprehensive multimodal multidisciplinary graduate education programs in the nation. As shown earlier, 61 courses were offered in the Spring and Summer 2015 and 375 courses have been offered since the inception of the program. The impact of the educational program will increase in future years, as the MPC universities expand the number of courses offered through their existing exchange program, in which students from any MPC university can take courses from other universities. These courses must be placed online for the collaborative exchange to work most effectively. Considerable progress has been made, thus far, in converting classroom courses to online courses and increasing the reach of the program.

**2. Workforce Development.** MPC’s technical training program is having a major impact in the region. Online modules, short courses, webinars, and on site/videoconferencing events are reaching state and local transportation department employees and tribal transportation planners. By harnessing the capabilities of the four LTAP centers located at the MPC universities and the multimedia capabilities of the Transportation Learning Network (which was founded and is partly funded by MPC) more than 30 technical training events were offered in the first half of 2105. These training modules and short courses are critical to transportation agencies that need to improve or renew the skills of engineering technicians and other frontline workers. Many MPC courses or training events result in the certification of workers. Even when certification is not required, TLN’s online learning management systems allow employees and employers to set learning goals and monitor progress towards these goals.

MPC is making another major impact in workforce development. Altogether, 102 graduate students are working on MPC research projects under the tutelage of faculty researchers. These graduate students represent the researchers and technical analysts of tomorrow. Without the MPC program and the stipend funds that it provides, these students may not be specializing in transportation; but, instead would be seeking career opportunities in other fields. The MPC research program allows faculty to mentor graduate students while allowing the students to work on projects for federal and state transportation agencies—thereby, gaining valuable practical experience.

**3. Tribal Transportation Technical Assistance.** The program is already having a major impact in terms of providing tools and assistance for Native American tribes in the region, especially those impacted by energy development in Wyoming and North Dakota. To better coordinate and plan tribal-related activities, NDSU has designated a tribal transportation program coordinator to help the director identify

critical needs and leverage resources to meet those needs. Technical assistance is already being provided in road safety, GIS transportation model building, forecasting heavy truck traffic attributable to energy development, and facilities planning. An emergency response planning guidebook (to help tribes plan for and respond to natural disasters that impact the transportation system and the delivery of life-saving services) is currently under development and will be disseminated within the region and the western United States when completed.

**4. Research.** During this rating period eight research projects have been completed and final reports published that address critical regional and national issues. Multiple journal articles and conference papers have been derived from each project, increasing their reach and impact. MPC's strategy of requiring journal articles and presentations at national conferences (such as TRB and the Transportation Research Forum) is greatly magnifying the impacts of the research projects and MPC reports.

**5. Leadership.** MPC researchers and program administrators are having a major impact through participation in TRB, TRF, ITE, and other national organizations and conferences. Moreover, MPC is a leader in responding to the dynamic and sometimes unprecedented transportation demands and issues posed by shale energy development. MPC research projects in Wyoming and North Dakota are helping impacted states and local/tribal governments develop long-term road and bridge investment strategies. The newly formed North Dakota Transportation Safety Advisory Group (which includes representation from NDDOT, North Dakota Highway Patrol, FRA, PHMSA, and FMCSA) is identifying critical research projects for 2015-2016 and leveraging technical assistance and training for transportation operators, emergency responders, and state and local planners. Even though MPC's primary focus is State of Good Repair, MPC has responded quickly to urgent requests for safety training and research in light of the unprecedented issues associated with the transportation of Bakken crude oil via rail, pipeline, and truck.

**5. Changes/Problems -** Nothing to report at this time.

**5a. Additional Information Regarding Products and Impacts -**Nothing to report at this time.

**PROGRAM OUTPUTS:** Nothing to report at this time.

**PROGRAM OUTCOMES:** Nothing to report at this time.

**PROGRAM IMPACTS:** Nothing to report at this time.

**6. SPECIAL REPORTING REQUIREMENTS:** None