

**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
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**North Dakota State University
Upper Great Plains Transportation Institute
NDSU Dept. 2880, P.O. Box 6050, Fargo, ND 58108-6050**

Grant period: January 1, 2012 – January 31, 2016

**Reporting Period End Date: December 31, 2013
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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 are 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 Competiveness, while addressing critical issues of the region and stakeholder groups—especially issues in the rapidly growing Bakken oil production region. Under grant DTRT13-G-UTC38, the focus will shift more toward State of Good Repair. However, some safety emphasis is still necessary, given the issues posed by the transportation of Bakken crude oil by rail and truck.

b. What was accomplished under these goals?

i. Project Selection and Peer Review

Under grant DTRT12-G-UTC08, 46 research projects have been selected from federal fiscal year (FY) 2011 funds—which were received in 2012. An additional 36 research projects have been selected from FY 2012 funds—which were received in 2013. Additional projects are currently being selected from FY 2012 funds to address critical issues in the Bakken, using match provided by the North Dakota legislature. All projects have been (and will be) 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 1-6, 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 Competiveness benefits.

Table 1: MPC Research Projects Most Directly Correlated with Safety

1. MPC-354: Geotechnical Limit to Scour at Spill-through Abutments (Year 2)
2. MPC-363: A Two-stage Approach for Estimating a Statewide Truck Trip Table
3. MPC-366: Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks, Phase I – Instrumentation Development and Validation
4. MPC-367: Developing Statistical Models for Crash Severity Comparing Statewide, County and Indian Reservation Roads
5. MPC-368: Effectiveness of Advisory Letter in Preventing At-Risk Teen Driver Crashes: Pilot Project
6. MPC-369: ND Motor Crash Analysis and Rider Assessment for Improved Conspicuity
7. MPC-370: Anticipatory Guidance for Older Drivers
8. MPC-371: Decision Support for Strategic Truck Safety and Weight Enforcement Planning
9. MPC-373: Damage Assessment, Characterization, and Modeling for Enhanced Design of Concrete

Table 1: MPC Research Projects Most Directly Correlated with Safety

Bridge Decks in Cold Regions

10. MPC-374: An Integrated Real-Time Health Monitoring and Impact/Collision Detection System for Bridges in Cold Remote Regions
11. MPC-375: Small Railroad Capital Investment Needs and Financial Options
12. MPC-378: MEMS Sensors for Transportation Structures
13. MPC-380: Investigation of Interactions Between Traffic Law Enforcement and Driving Behavior on Rural Highways in Colorado
14. MPC-381: Performance-based Interaction Analysis of Damage on Bridge Expansion Joints and Heavy Traffic
15. MPC-382: Seismic Behavior of Steel Bridges with Fatigue-prone Details
16. MPC-386: Use of Travel Time, Travel Time Reliability, and Winter Condition Index Information for Improved Operation of Rural Interstates
17. MPC-397: Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
18. MPC-401: Review of Road User Costs (RUC) and Methods
19. MPC-402: Seismic Performance of SCC Bridge Columns
20. MPC-406: Risk- and Reliability-Based Approaches to Analyzing Road Geometric Design Criteria
21. MPC-407: The Effect of Multi-tasking on Self-Assessments of Driving Performance Center for the Prevention of Distracted Driving
22. MPC-408: Exploring Unique Plastic-Reinforced Bridge Decks: Phase I
23. MPC-409: Identification of Low-Risk Adjusted Work Schedules Designed to Manage Fatigue During Peak Service Demand Periods in the Shortline Railroad Industry
24. MPC-416: Development and Testing of Crashworthy Ipe Bridge Rails
25. MPC-418: 400 South Corridor Assessment
26. MPC-423: Impact of Energy Sector Growth on Perceived Transportation Safety in the Seventeen County Oil Region of Western North Dakota: A Longitudinal Analysis
27. MPC-425: Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
28. MPC-431: Connected Vehicle Weather Data for Operation of Rural Variable Speed Limit Corridors
29. MPC-432: Finding Innovative Solutions to Prevent Wildlife Access to Highways at Wildlife Guards
30. MPC-433: Real-Time Traffic Management to Maximize Throughput of Automated Vehicles
31. MPC-434: A Bicycle Network Analysis Tool for Planning Applications in Small Communities
32. MPC-435: Realization of a Coarse Position Verification System for an Automated Highway System
33. MPC-438: Calibration of HSM Predictive Methods on Rural State and Local Highways

Table 2: 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-362: Develop Design Guidelines for Integral Abutment Bridges
3. MPC-363: A Two-stage Approach for Estimating a Statewide Truck Trip Table
4. MPC-366: Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks, Phase I – Instrumentation Development and Validation
5. MPC-371: Decision Support for Strategic Truck Safety and Weight Enforcement Planning
6. MPC-372: A Novel Methodology for Quantifying the Performance of Constructed Bridges in Cold Regions: Development, Assessment, and Repair
7. MPC-373: Damage Assessment, Characterization, and Modeling for Enhanced Design of Concrete Bridge Decks in Cold Regions
8. MPC-374: An Integrated Real-Time Health Monitoring and Impact/Collision Detection System for Bridges in Cold Remote Regions
9. MPC-375: Small Railroad Capital Investment Needs and Financial Options
10. MPC-376: Improved Understanding of Pavement Impacts and Cost-Effective Designs Based on

Table 2: MPC Research Projects Most Directly Correlated with State of Good Repair

Mechanistic-Empirical Methods

11. MPC-378: MEMS Sensors for Transportation Structures
12. MPC-379: Plastic-Aluminum Composites in Transportation Infrastructure
13. MPC-382: Seismic Behavior of Steel Bridges with Fatigue-prone Details
14. MPC-383: Seismic Performance of Highway Embankments
15. MPC-387: Comprehensive GIS-Based Rural Regional Transportation Planning Models
16. MPC-390: Design and Construction Monitoring of Surcharged Embankment
17. MPC-391: Implementation of Low Temperature Test for Asphalt Mixtures to Improve the Longevity of Road Surfaces
18. MPC-394: Quantifying Uncertainty in Nondestructive Bridge Inspection Methods for use in Performance Based Inspection
19. MPC-395: Accelerated Bridge Construction in South Dakota: Pilot Study for Implementation Strategy
20. MPC-396: Extent, Severity, and Location of Chip Seal Loss on the South Dakota State Road Network
21. MPC-397: Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
22. MPC-398: Selection of Discount Rates for Infrastructure Investment
23. MPC-400: Evaluation of Ice Loads on Bridge Piers in South Dakota (Years 2 & 3)
24. MPC-401: Review of Road User Costs (RUC) and Methods
25. MPC-402: Seismic Performance of SCC Bridge Columns
26. MPC-404: Seismic Performance of Concrete Filled Steel Tube (CFST) Bridge Columns For Accelerated Bridge Construction
27. MPC-405: Seismic Retrofit of Spliced Sleeve Connections for Precast Bridge Piers
28. MPC-406: Risk- and Reliability-Based Approaches to Analyzing Road Geometric Design Criteria
29. MPC-409: Identification of Low-Risk Adjusted Work Schedules Designed to Manage Fatigue During Peak Service Demand Periods in the Shortline Railroad Industry
30. MPC-410: Predicting Fatigue Service Life Extension of RC Bridges with Externally Bonded CFRP Repairs
31. MPC-411: Re-Use of Mine Waste Materials Amended with Fly Ash in Transportation Earthwork Projects
32. MPC-412: Fatigue Strength of CFRP-repaired Reinforced Concrete Bridge Girders under Service Temperature
33. MPC-413: A Pilot Case Study to Evaluate the Potential Impact and Benefit of Adopting and Implementing BIM on Bridge and Infrastructure Projects
34. MPC-414: Quantifying Sustainability Metrics for Trunkline Bridges in the Mountain Plains Region
35. MPC-415: Framework of Performance-Based Earthquake Design of Curved and Skewed Bridges
36. MPC-419: Experimental and Numerical Study for the Debonding Interface Between an Existing Pavement and a New Concrete Overlay
37. MPC-421: Seismic Rehabilitation of Skewed and Curved Bridges Using a New Generation of Bulking Restrained Braces
38. MPC-422: Highway Structures Supported on Expanded Polystyrene (EPS) Embankment without Deep Foundations
39. MPC-423: Impact of Energy Sector Growth on Perceived Transportation Safety in the Seventeen County Oil Region of Western North Dakota: A Longitudinal Analysis
40. MPC-425: Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
41. MPC-427: Fire Performance of Bridge Members Retrofitted with Near-Surface-Mounted Carbon Fiber Reinforced Polymer Composites
42. MPC-428: Using Recycled Concrete Aggregate in New Concrete Construction
43. MPC-429: A Methodology for Developing a Replacement Strategy for County/City Owned Bridges
44. MPC-430: Implementation of Intelligent Compaction Technologies for Road Constructions in Wyoming

Table 2: MPC Research Projects Most Directly Correlated with State of Good Repair

45. MPC-432: Finding Innovative Solutions to Prevent Wildlife Access to Highways at Wildlife Guards
46. MPC-434: A Bicycle Network Analysis Tool for Planning Applications in Small Communities
47. MPC-437: Fiber Reinforced Concrete for Structure Component
48. MPC-439: Precast Bridge Girder Details for Improved Performance
49. MPC-440: Tolerances for Placement of Tie Bars in Portland Cement Concrete Pavements
50. MPC-441: Developing a Pavement Management System for Small Communities
51. MPC-442: Improving Rural Emergency Medical Services (EMS) through Transportation System Enhancements, Phase II
52. MPC-443: Bridge Structure Alternatives for Local Roads

Table 3: MPC Research Projects Most Directly Correlated with Economic Competitiveness

1. MPC-354: Geotechnical Limit to Scour at Spill-through Abutments (Year 2)
2. MPC-363: A Two-stage Approach for Estimating a Statewide Truck Trip Table
3. MPC-364: Do Changing Prices Portend a Shift in Fuel Consumption, Diminished Greenhouse Gas Emissions, and Lower Fuel Tax Revenue?
4. MPC-366: Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks, Phase I – Instrumentation Development and Validation
5. MPC-375: Small Railroad Capital Investment Needs and Financial Options
6. MPC-379: Plastic-Aluminum Composites in Transportation Infrastructure
7. MPC-380: Investigation of Interactions Between Traffic Law Enforcement and Driving Behavior on Rural Highways in Colorado
8. MPC-381: Performance-based Interaction Analysis of Damage on Bridge Expansion Joints and Heavy Traffic
9. MPC-382: Seismic Behavior of Steel Bridges with Fatigue-prone Details
10. MPC-384: Understanding Public Perceptions of Different Revenue Generation Systems for Highway Construction and Maintenance
11. MPC-387: Comprehensive GIS-Based Rural Regional Transportation Planning Models
12. MPC-395: Accelerated Bridge Construction in South Dakota: Pilot Study for Implementation Strategy
13. MPC-396: Extent, Severity, and Location of Chip Seal Loss on the South Dakota State Road Network
14. MPC-397: Evaluation and Mitigation of Vehicle Impact Hazard for Overpass Bridges in South Dakota
15. MPC-398: Selection of Discount Rates for Infrastructure Investment
16. MPC-401: Review of Road User Costs (RUC) and Methods
17. MPC-402: Seismic Performance of SCC Bridge Columns
18. MPC-408: Exploring Unique Plastic-Reinforced Bridge Decks: Phase I
19. MPC-418: 400 South Corridor Assessment
20. MPC-422: Highway Structures Supported on Expanded Polystyrene (EPS) Embankment without Deep Foundations
21. MPC-425: Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
22. MPC-426: Does the Livability of a Residential Street Depend on the Characteristics of the Neighboring Street Network?
23. MPC-427: Fire Performance of Bridge Members Retrofitted with Near-Surface-Mounted Carbon Fiber Reinforced Polymer Composites
24. MPC-433: Real-Time Traffic Management to Maximize Throughput of Automated Vehicles
25. MPC-435: Realization of a Coarse Position Verification System for an Automated Highway System
26. MPC-437: Fiber Reinforced Concrete for Structure Component
27. MPC-439: Precast Bridge Girder Details for Improved Performance
28. MPC-440: Tolerances for Placement of Tie Bars in Portland Cement Concrete Pavements
29. MPC-443: Bridge Structure Alternatives for Local Roads

Table 4: 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-376: Improved Understanding of Pavements Impacts and Cost-Effective Designs Based on Mechanistic-Empirical Methods
3. MPC-379: Plastic-Aluminum Composites in Transportation Infrastructure
4. MPC-380: Investigation of Interactions between Traffic Law Enforcement and Driving Behavior on Rural Highways in Colorado
5. MPC-381: Performance-based Interaction Analysis of Damage on Bridge Expansion Joints and Heavy Traffic
6. MPC-387: Comprehensive GIS-Based Rural Regional Transportation Planning Models
7. MPC-392: Evaluation of Spliced Sleeve Connections for Precast Reinforced Concrete Bridge Piers
8. MPC-393: Traffic Modeling of Transit Oriented Development
9. MPC-399: Improving Rural Emergency Medical Services (EMS) through Transportation System Enhancements
10. MPC-408: Exploring Unique Plastic-Reinforced Bridge Decks: Phase I
11. MPC-417: Evaluation and Development of Livability and Sustainability Programs for Indian Reservations
12. MPC-418: 400 South Corridor Assessment
13. MPC-425: Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
14. MPC-426: Does the Livability of a Residential Street Depend on the Characteristics of the Neighboring Street Network?
15. MPC-436: Using Flocculation to Reduce Turbidity of Construction Site Runoff
17. MPC-438: Calibration of HSM Predictive Methods on Rural State and Local Highways

Table 5: 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 6: MPC Education Projects

1. MPC-403: Web-based Decision Support Tool for Traffic Management and Work Zone Analysis
2. MPC-424: Educational and Workforce Development: Ethics and Academic Conduct

Peer review of potential projects to be funded with grant DTRT13-G-UTC38 is currently underway. This grant was initially implemented in November of 2013. As a result, grant administration procedures are still being implemented. For this reason, no projects have yet been selected under DTRT13-G-UTC38.

ii. Educational Accomplishments

The transportation and transportation-related courses offered during fall 2013 are listed in Table 7, 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 7: Transportation and Transportation-Related Courses Offered This Reporting Period

Major Subject Area	Course Title
Engineering & Design	Advanced Material Testing (graduate)
	Advanced Mechanics of Materials (graduate)
	Advanced Reinforced Concrete
	Advanced Street & Highway Design
	Civil Engineering Computer Aided Design
	Design and Behavior of Steel Structures (undergraduate)
	Engineering Applications of GIS and GPS (graduate)
	Foundation Engineering (2)
	Geology
	Geometric Design of Highways (2)
	Highway Capacity Analysis
	Highway Engineering
	Intermediate Structural Analysis (graduate)
	Pavement Design undergraduate and graduate
	Professional Practice and Design undergraduate
	Quantitative Tools for Transportation Management
	Reinforced Concrete Theory and Design
	Structural Reliability: Theory and Application (graduate)
	Surveying
	Transportation Engineering (3)
Transportation Engineering (undergraduate)	
Freight & Logistics	Logistics Systems
	Principles of Supply Chain: Management and Technologies
	Transportation Marketing and Sales Tools
Planning & Environment	Case Studies in Sustainable Transportation
	Introduction to Sustainable Urban Infrastructure
	Leadership Development Planning Project
	Planning Healthy Communities
	Transportation and Land Use
	Transportation Economics
	Transportation Law and Regulation: Domestic and International
	Transportation Management, Leadership, and Values
	Transportation Planning & Environmental Compliance
	Transportation Planning and Policy
Urban and Regional Transportation Planning	
Public Transportation	Passenger Transportation Systems
Traffic & Operations	Advanced Traffic Control

Table 7: Transportation and Transportation-Related Courses Offered This Reporting Period

Major Subject Area	Course Title
	Intelligent Transportation System ITS
	Supply Chain Strategy
	Traffic Engineering
	Traffic Flow Theory Graduate
	Traffic Operations and Control
	Transportation Finance
	Transportation Marketing and Sales Tools
	Urban Transportation Systems Analysis
Transportation Safety	Traffic and Safety Data Analysis
Transportation Systems	4950 Intermodal Business Planning Project
	Freight Transportation Systems
	Intermodal Transportation Systems
	Introduction to Transportation Systems
	Passenger Transportation Systems
	Statistical and Econometric Analysis Graduate
	Transportation Systems I
	Transportation Systems Security

Altogether, 54 transportation and transportation-related courses have been offered during this reporting period. Altogether, 203 transportation courses have been offered during the grant period thus far. In addition to the courses listed in Table 7, 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. Accelerated Bridge Construction in South Dakota: Pilot Study for Implementation Strategy
2. Aggregate Certification
3. All about Soil
4. Alternatives to Paving - Video Conference
5. Annual Regional Local Roads Conference (Rapid City, SD On-site)
6. Anti-Icing and De-Icing - Video Conference
7. Asphalt certification
8. ATSSA Flagger Certification
9. ATSSA Traffic Control Supervisor
10. ATSSA Traffic Control Technician (TCT)
11. Basic Overview of NEPA and Associated Federal Legislation - Video Conference
12. Civil Engineer PE Exam Preparation (Webinar)
13. Concrete Certification
14. Concrete training
15. Delivering Leading-Edge Customer Service - Video Conference
16. EDC Exchange for Local & Tribal Agencies (Webinar)
17. Ethics Awareness for the Transportation Industry - Video Conference
18. Follow-up to Slide Design for Non-Designers: Presenting Technical Data (Webinar)

19. Heavy Equipment Operation (Hands-on)
20. Heavy Equipment Safety Operations
21. Integrated Roadside Vegetation Management
22. Leading a Successful Change Effort - Video Conference
23. OSHA 10-hr Work Zone Safety - Video Conference
24. Retroreflectivity for Signs
25. Slide Design for Non-Designers: Presenting Technical Data (Webinar)
26. Snowplow Operator Training (Video Conference)
27. Street Lighting
28. Successful Meetings or Trainings Using Distance Technology (Webinar)
29. Tree Trimming
30. Truck Weight Education & Outreach (Devils Lake, ND On-site)
31. Truck Weight Education & Outreach (Dickinson, ND On-site)
32. Truck Weight Education & Outreach (Grafton , ND On- site)
33. Truck Weight Education & Outreach (Jamestown, ND On-site)
34. Truck Weight Education & Outreach -(Mandan, ND On-site)
35. Truck Weight Education & Outreach -(Washburn, ND On-site)
36. Truck Weight Education & Outreach (Williston, ND Onsite)
37. Using Risk to Drive Safety Investments (KSDOT Webinar)
38. Winter Road Maintenance
39. Winter Roads Maintenance for Local Roadways (Bismarck, ND On-site)
40. Winter Roads Maintenance for Local Roadways (Carrington, ND On-site)
41. Winter Roads Maintenance for Local Roadways (Devils Lake, ND On-site)
42. Winter Roads Maintenance for Local Roadways (Dickinson , ND On-site)
43. Winter Roads Maintenance for Local Roadways (Fargo, ND On-site)
44. Winter Roads Maintenance for Local Roadways (Stanley, ND On-site)
45. Winter Roads Maintenance for Local Roadways (Williston, ND On-site)

iv. Research accomplishments

The following peer reviewed research reports were published in 2013 from grant DTRT12-G-UTC08 or previous grants.

Project #	Title	Date	Report No.
248	Wyoming Freight Movement System Vulnerabilities and ITS	Dec. 2013	MPC 13-261
287	Performance of Reclaimed Asphalt Pavement on Unpaved Roads	May 2013	MPC 13-251
313	Evaluation of Transit Signal Priority Strategic for Bus Rapid Transit Project on 3500 South Street in Salt Lake County, UT	July 2013	MPC 09-213
318	Effectiveness of Various Safety Improvements in Reducing Crashes on Wyoming Roadways	Dec. 2013	MPC 13-262
325	Fatigue Testing of Wood-Concrete Composite Beams	May 2013	MPC 13-252
337	Analysis of Railroad Energy Efficiency in the United States	May 2013	MPC 13-250
340	Long-Term Monitoring of Mechanical Properties of FRP Repair Materials	June 2013	MPC 13-253
341	Off-Grid MEMS Sensors Configurations for Transportation Applications	Oct. 2013	MPC 13-257
342	Seismic Vulnerability Analysis of Bridges in Mountainous States	Sep. 2013	MPC 13-255
347	Misinformation Contributing to Safety Issues in Vehicle Restraints for Children: A Rural/Urban Comparison	Dec. 2013	MPC 13-264
362	Behavior and Analysis of an Integral Abutment Bridge	Sep. 2013	MPC 13-256
391	Implementation of Low Temperature Tests for Asphalt Mixtures	Dec. 2013	MPC 13-260

Project #	Title	Date	Report No.
401	to Improve the Longevity of Road Surfaces Review of Road User Costs and Methods	July 2013	MPC 13-254

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 for spring and first summer semesters. (2) Select research projects for the first year of funding under grant DTRT13-G-UTC38. (3) Schedule and deliver another extensive program of technical training, similar to the program illustrated in b.iii. (4) 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. (5) 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. (6) Continue the strong MPC research program, which will result in many new publications and journal papers. (7) Participate in 4 or more conferences and workshops on transportation and energy development. (8) 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

- 7th International Structural Engineering and Construction Conference
- Annual Meeting of the Great Plains Sociological Association
- AASHTO GIS-T 2013 Conference
- Seattle Bicycle Urbanism Symposium
- American Concrete Institute Convention
- International Structural Engineering and Construction Conference
- Global Sustainability, Transportation, and the Supply Chain Conference, University of Denver
- METRANS Urban Freight Conference
- Wasatch Front Regional Council Fall Consortium, Salt Lake City, UT
- Utah Department of Transportation Annual Conference, Salt Lake City, UT
- DTA Modeling Workshop at Wasatch Front Regional Council, Salt Lake City, UT

- Eighth SHRP 2 Safety Research Symposium
- Institute of Transportation Engineers Annual Conference
- National Rural ITS Conference
- 17th Hong Kong Society of Transportation Studies Conference
- Transportation Research Board Summer Waterway and Rail Transportation Conference

ii. Key Journal Articles or Conference Publications

- Telste, M. and Yang, M. “A Deformation Distribution Based Bridge Health Monitoring Methodology,” 2013 ACI Congress, April 13-16, 2013, Minneapolis, MN
- Ahmari, S., Yang, M.J. “Impact Load Identification through Measurement with Uncertainty,” *Journal of Smart Materials and Structures*
- Ahmari, S., Yang, M.J. “Dynamic Behavior of Deck-Girder System of Bridges Subjected to Settlement through Finite Strain Plate Theory,” submitted to *Journal of Sound and Vibration* (currently in revision)
- Zhong, H., Yang, M.J., “Prediction of Pre-stress Loss through Dynamics of Bridge and Vehicle Interaction,” submitted to *International Journal of Solids and Structures* (Pending)
- Qin, X., Shen, Zhao, Wehbe, N., Pei, S., and He, Z. “Evaluation of Truck Impact Hazards for Interstate Overpasses,” submitted for publication at 93rd annual meeting of the Transportation Research Board
- Wehbe, N. and Malhas, M., “Characteristics of Self-Consolidating Concrete for Bridge Girders,” *International Journal of Engineering Research and Innovation*, Vol. 5, No. 1, Spring/Summer 2013, pp. 16 – 23
- Wehbe, N. and Stripling, C., “Experimental Assessment of Flexural Strength and Serviceability of Pre-stressed SCC Bridge Girders with Composite Decks,” *KSCCE Journal of Structural Engineering*, Vol. 17, No. 3, April 2013, pp. 540 – 549
- Kim, Y.J., Yoshitake, I., and Yang, M. “A Predictive Investigation Associated with Design Recommendations for CFRP-confined Concrete in Aggressive Service Environments,” *Construction and Building Materials*, Elsevier, 43, 69-79, 2013
- Kim, Y.J., LaBere, J., and Yoshitake, I. “Hybrid Epoxy-Silyl Modified Polymer Adhesives for CFRP Sheets Bonded to a Steel Substrate,” *Composites Part B*, Elsevier, 51, 233-245, 2013
- Johnson, etal. “Association of Sleep Habits with Accidents and Near Misses in United States Transportation Operators;” *Journal of Occupational and Environmental Medicine*; accepted for publication
- Clendennen, C., and Romero, P.: “Evaluating the Representative Volume Element of Asphalt Concrete Mixture Beams for Testing in the Bending Beam Rheometer.” *Multi-Scale Modeling and Characterization of Infrastructure Materials*, N. Kringos, B. Birgisson, D. Frost, and L. Wang, Eds. Stockholm, Sweden ISBN 978-94-007-6877-2. Pp. 13-30 (10-12 June, 2013)
- Ho, C.H. and Romero, P.: “Characterizing the Low-Temperature Viscoelastic Behavior of Asphalt Mixtures: A Comparative Study.” *International Journal of Pavement Research and Technology*. ISSN 1996-6834. Vol. 6 No. 5. Pp. 479-487 (Sept. 2013)
- Ho, C.H. and Romero, P: “Using Linear Viscoelastic Modeling to Evaluate the Low Temperature Properties of Asphalt Mixtures Prepared with Aggregates of Different Sizes.” Paper ACEM-2012-0040.R1. *ASTM’s Journal of Advances in Civil Engineering Materials* Vol. 2, No 1. Pp. 122 – 139 (2013)

- M.J. Ameli, J.E. Parks, D.N. Brown, and C.P. Pantelides. "Grouted Splice Sleeve Connection Alternatives for Precast Reinforced Concrete Bridge Piers in Moderate-to-High Seismic Regions." Accepted for presentation at the 10th US National Conference for Earthquake Engineering, Anchorage, AK, July 21-25, 2014
- Tasic, I., X. Zhou, M. Zlatkovic. "Using Spatio-temporal Constraints to Quantify Transit Accessibility: Case Study of Potential Transit-Oriented Development Location in West Valley, Utah." Accepted for a presentation at the Transportation Research Board Annual Meeting, Washington, D.C., 2014
- Tasic, I., M. Zlatkovic. "Evaluating Performance of Innovative Intersections in Potential Transit Oriented Development." Accepted for a presentation at the Transportation and Development Institute Annual Congress, Orlando, FL
- Zlatkovic, M., and X. Zhou. "Effective Coupling of Signal Timing Estimation Model and Dynamic Traffic Assignment in 1 Feedback Loops: System Design and Case Study." Accepted for Proceedings of the TRB 93rd Annual Meeting. Washington, D.C.
- Tucker, C. and Ibarra, L. "Seismic Performance of Circular Concrete Filled Tube Columns for Accelerated Bridge Construction." Submitted for Proceedings of the Tenth National Conference on Earthquake Engineering. Anchorage, Alaska, July 21-25, 2014
- C.P. Pantelides, L.D. Reaveley, J.E. Parks, M.J. Ameli, and D.N. Brown. "Repair of Damaged Bridge Column-to-Pier Cap Fastened/Grouted Splice Sleeved Connection using FRP Shells and Plastic Hinge Relocation." Accepted. American Concrete Institute (ACI), Sustainable Solutions for Seismic Repair of Bridges, Sponsored by ACI Committee 341, Earthquake-Resistant Bridges, Phoenix, AZ, Oct. 22, 2013
- C.P. Pantelides, L.D. Reaveley, J.E. Parks, M.J. Ameli, and D.N. Brown. "Repair of Damaged Bridge Column-to-Footing Grouted Splice Sleeved Connection using FRP Jacketing and Plastic Hinge Relocation" accepted. American Concrete Institute (ACI), Sustainable Solutions for Seismic Repair of Bridges, Sponsored by ACI Committee 341, Earthquake-Resistant Bridges, Phoenix, AZ, Oct. 22, 2013
- J.E. Parks, D.N. Brown, M.J. Ameli, C.P. Pantelides and L.D. Reaveley. "Repair of Damaged Precast RC Bridge Columns with Grouted Splice Sleeve Connections using CFRP Shells and Plastic Hinge Relocation." Accepted for presentation at the 10th US National Conference on Earthquake Engineering, Anchorage, AK, July 21-25, 2014
- Musunuru, A. and Porter, R.J. "A Reliability-Based Geometric Design Approach to Freeway Number of Lanes Decisions." Submitted to Transportation Research Record: Journal of the Transportation Research Board, August 2013
- Tasic, I., Musunuru, A., and Porter, R.J. "Quantifying Accessibility of Non-Motorized Transportation Modes in Recreational Areas: Case Study of Mill Creek Canyon, Utah." Submitted to the Journal of Park and Recreation Administration, July 2013
- Zlatkovic, M., and A. Stevanovic. "Assessment of Impacts of Increased Train Frequency and Predictive Transit Priority on a LRT Corridor in Salt Lake City." Proceedings of the TRB 93rd Annual Meeting, Washington D.C.
- MPC-S., Chen, A., Ryu, S. "An Alternative Approach for Estimating a Statewide Truck Origin-Destination Trip Table: A Case Study in Utah." 93rd Transportation Research Board Annual Meeting, Washington D.C.
- Desiraju, Divya, Thidapat Chantem, and Kevin Heaslip. Minimizing the Disruption of Traffic Flow of Automated Vehicles during Lane Change. IEEE Transactions on Intelligent Transportation Systems (under review)

iii. Key Conference Papers

- Fanning, B., Clevenger, C., Ozbek, M., and Vonfeldt, S. "Construction Graduate Internships in Support of Best Practice Applied Research." Submitted to the Associated Schools of Construction (ASC) 50th Annual International Conference to be held in conjunction with the CIB Workgroup 89 - March 26-28, 2014, Washington, DC.
- Fanning, B., Clevenger, C., Ozbek, M., and Mahmoud, H. "Investigating the Role of BIM to Facilitate Sustainable Infrastructure Construction." Submitted to the International Conference on Sustainable Infrastructure to be held November 6-8, 2014 Long Beach, California
- A. Reberg, S. Yazdani, S. Borgersen, M. Yang, and Y. Kim, "Modeling of Fatigue type Processes with Damage Mechanics" Proceedings of the 7th International Structural Engineering and Construction Conference, Honolulu, Hawaii, 2013
- A. Reberg, S. Yazdani, S. Borgersen, M. Yang, and Y. Kim, "Impact Location and Load Identification through Inverse Analysis with Bounded Uncertain Measurements," SPIE Smart Structures/NDE March 9-13, 2014, Town & Country Resort and Convention Center, San Diego, California, United States. PAPER NUMBER: 9061-48
- Lee, E. "Long Range Transportation Planning Dealing with Oil." Proceedings of the 2013 GIS-T Symposium. Boise, ID, 2013
- Lee, E. "Connectivity and Equality Consequence of Emergency Medical Services." Proceedings of the 2013 GIS-T Symposium. Boise, ID, 2013
- Wehbe, N. and Stripling, J., "Development of Highway Pavement Concrete Mixtures for Enhanced Durability and Workability," Proceedings of the 7th International Structural Engineering and Construction Society Conference: New Developments in Structural Engineering and Construction, June 18-23, 2013, Honolulu, HI, pp. 1055-1060
- Kim, Y.J., Siriwardanage, T., Yoshitake, I., Yazdani, S., and Yang, M. "Silyl Modified Polymer for Steel Members Strengthened with CFRP," 7th International Structural Engineering and Construction Conference (ISEC-7), Honolulu, HI, USA, 2013
- C.P. Pantelides, L.D. Reaveley, J.E. Parks, M.J. Ameli, and D.N. Brown. "Repair of Damaged Bridge Column-to-Pier Cap Fastened/Grouted Splice Sleeved Connection using FRP Shells and Plastic Hinge Relocation." Proceedings of American Concrete Institute (ACI), Sustainable Solutions for Seismic Repair of Bridges, Sponsored by ACI Committee 341, Earthquake-Resistant Bridges, Phoenix, AZ, Oct. 22, 2013
- Jansuwan, S., Chen, A. "Estimating a Statewide Truck Origin-Destination Trip Table: A Case Study in Utah." Paper presented to the 17th Hong Kong Society of Transportation Studies Conference: Transportation & Logistics Management, December 17-20, 2012, Hong Kong, P.R. China
- Jansuwan, S., Chen, A., Ryu, S. (2014) An Alternative Approach for Estimating a Statewide Truck Origin-Destination Trip Table: A Case Study in Utah. Paper accepted for the 93rd Transportation Research Board Annual Meeting, Jan. 12-16, 2014, Washington D.C., USA

iv. Key Presentations

- Telste, M., Yang, M. "A Deformation Distribution Based Bridge Health Monitoring Methodology," ACI Congress
- A. Reberg, S. Yazdani, S. Borgersen, M. Yang, and Y. Kim "Modeling of Fatigue Type Processes with Damage Mechanics," Proceedings of the 7th International Structural Engineering and Construction Conference.
- Vachcal, K. "Impact of Energy Sector Growth on Perceived Transportation Safety in the Seventeen County Oil Region of Western North Dakota: A Longitudinal Analysis"

- Kubas, A. "Oil County Traffic Safety: A Perspective of Western North Dakota Residents." Great Plains Sociological Association Annual Conference
- Lee, E. "Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program," AASHTO GIS-T 2013 Conference. Boise, ID
- Lee, E. "Geospatial Information Systems for Transportation," North Dakota GIS User Conference
- Shen, Z., Qin, X., Wehbe, N., Pei, S. and Tigges, B. "Evaluation and Mitigation of Vehicle Impact Hazards for Overpasses," AASHTO GIS-T 2013 Conference. Boise, ID, May 2013
- Kim, Y.J., Siriwardanage, T., Yoshitake, I., Yazdani, S., and Yang, M. "Silyl Modified Polymer for Steel Members Strengthened with CFRP," 7th International Structural Engineering and Construction Conference (ISEC-7), Honolulu, HI
- Sherry, P. (2013). "Health Effects of Involvement in Railroad Critical Incidents," National Institute for Occupational Safety and Health (NIOSH), American Psychological Association (APA), Los Angeles California
- Bondanza, A. & Sherry, P.. "Psychological Growth Following Involvement in Critical Incidents," Annual Meeting of the Transportation Research Forum, Baltimore, MD
- Hedman, B., & Sherry, P. "Further Validation of a Measure of Organizational Inclusiveness in the Transportation Industry," Organizational Psychology Society, Vancouver, BC, CA
- Tasic, I., X. Zhou, M. Zlatkovic. "Traffic Modeling of Transit Oriented Development," Wasatch Front Regional Council Fall Consortium, Salt Lake City, UT, 2013
- Tasic, I., X. Zhou, M. Zlatkovic. "Using Spatio-temporal Constraints to Quantify Transit Accessibility: Case Study of Potential Transit-Oriented Development Location in West Valley, Utah" Utah Department of Transportation Annual Conference, Salt Lake City, UT, 2013
- C.P. Pantelides, L.D. Reaveley, "Seismic Retrofit of Spliced Sleeve Connections for Precast Bridge Piers" J.E. Parks, M.J. Ameli, and D.N. Brown. "Repair of Damaged Bridge Column-to-Pier Cap Fastened/Grouted Splice Sleeved Connection using FRP Shells and Plastic Hinge Relocation." Presented at American Concrete Institute (ACI), Sustainable Solutions for Seismic Repair of Bridges, Sponsored by ACI Committee 341, Earthquake-Resistant Bridges, Phoenix, AZ, Oct 2013
- Ray, Brian and R.J. Porter, NCHRP 15-34, "Performance Based Analysis of Geometric Design of Highways and Streets," Safety Effects of Geometric Design Workshop, Irvine, CA, July 2013
- Chakradhar, R. "Geotechnical Limit to Scour at Spill-through Abutments," University of Wyoming Graduate Research Day, November 2013
- Savan, C. "Implementation of Intelligent Compaction Technologies for Road Constructions in Wyoming" Graduate Student Symposium. Department of Civil and Architectural Engineering, University of Wyoming, Laramie, WY, November 2013

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

Nothing to report at this time.

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

- The MPC website is fully operational at: <http://www.mountain-plains.org/>
- MPC-403: Web-based Decision Support Tool for Traffic Management and Work Zone Analysis; <http://code.google.com/p/nexta/>

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

- CSU graduate student developed and presented a building information management plan to RTD in Denver, CO
- Ahmari, S., Yang, M. Impact/Collision Identification through Sensor Arrays, was accepted for publication in the Journal of Smart Materials and Structures
- MPC-375(Small Railroad Capital Investment Needs and Financial Options) informed FRA - internal report to FRA Administrator and FRA report to Congress
- SDSU research team developed excel-based software for ABC implementation in South Dakota
- MPC-406 (Risk- and Reliability-Based Approaches to Analyzing Road Geometric Design Criteria) produced a methodology for implementing a reliability-based geometric design approach for making decisions regarding the basic number of lanes on freeways. The framework allows highway designers to explicitly consider the probability distribution of operational performance that might result from different basic number of lanes decisions.

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 projects at **Utah State University** are: (1) Kevin Heaslip, University Program Coordinator and PI; (2) Anthony Chen, PI; (3) Ryan Bosworth, Co-PI; (4) Michael Thomas, PI; (4) Rebecca Winstead, TIMELab Administrator; (5) Patricia Cramer, PI; and (6) Thidapat (Tam) Chantem, PI. In addition, 9 students are participating in MPC research projects at **Utah State University**: Doctorate Students - Ali Soltani Sobh, Donghyung Yook, Sarawut Jansuwan, Seunkyu Ryu, Masters Students - Joespth Flower, Divya Desiraju, Niranjana Chandrappa, Undergraduate Students - Eric Meissner and Jaque Johansen. Others participating in MPC projects at **Utah State University** include Hugh Boyle (a consultant).

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Wyoming** are: (1) Khaled Ksaibati, University Program Coordinator and PI; (2) Robert Ettema, PI; (3) Rhonda Young, PI; (3) Richard J. Schmidt, PI; (4) Kam Ng, Co-PI; (5) Ed Kempema, Lab Director; and (6) James Branscomb, Engineer. Nine students participating in MPC research projects at the University of Wyoming: Doctorate Students: Edward Offet, Vijay Sabawat, Promoths Saha, Masters Students - Ram Chakradha, Mike Jung, Undergraduate Students - Chris Leclerc, McKenzie Danforth, Matthew Filla, and Britton Hammit.

Fourteen principal investigators, faculty, and administrators participating in MPC projects at the **University of Utah**: Richard Porter, University Program Coordinator and PI; Steven Bartlett, PI; Peter Martin, PI; Chris Pantelides, PI; Lawrence Reaveley, Co-PI; Pedro Romero, PI; Xuesong Zhou,

PI; David Strayer, PI; Luis Ibara, PI; David Sanbonmatsu, PI; Milan Zlatkovic, PI; Muhammad Farhan, PI; Amanda Bordelon, PI; and Jan Vaslestad, Co-PI. Nineteen graduate and undergraduate students are working on MPC research projects at the **University of Utah**: Doctorate Students – M.J. Ameli, Ivana Tasic, Tie Shi, Ramesh Newpane, Min Ook Kim; Masters Students - Zacgary Jones, Crystal R. Clendennen-Pierce, Joel Parks, Dylan Brown, Jonna Turrill, Anush Musunuru, Catherine Tucker, Jeffrey Taylor, James Coleman, Arwen Behrends, Shannon Moore, Anurag Upadhay, Zach Gibbs, Masters; and Francesco Biondi, Visiting Scholar.

Eight principal investigators, faculty, and administrators are participating in MPC projects at **South Dakota State University**: Nadim Wehbe, University Program Coordinator and PI; Allen Jones, PI; Xiao Qin, PI; Zhiguang Wang, PI; Shiling Pei, PI; Guanghui Hua, PI; Junwon Seo, Co-PI; and Seyed Ardakani, Co-PI. In addition, 14 graduate and undergraduate students are working on MPC research projects at **South Dakota State University**: Masters Students - Brittney Ahrenstorff, Chase Cutler, Todd Pauly, Melissa Tracy, Kai Wang, Zhao Shen, Zhaoxiang He, Jacob Humburg, Micah Underberg, Zhi Chen, Md. Shaon Razaur Rahman, Michael Konrad, Walker Olson, and Kofi Oppong.

Eight 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, Co-PI; Caroline Clevenger, PI; John vande Lindt, Co-PI; and Bolivar A. Senior, PI. In addition, 13 graduate and undergraduate students are working on MPC research projects at **Colorado State University**: Doctorate Students - Xiaoxiang Ma, Kristen Peterson, Luke Chen, Akshat Chulahwat; Masters Students - Paula Miller, Sherona Simpson, Tyler Sobieck, Nasser Alberuti, Dsl Divya, Blaine Fanning, Thomas Wilson, and Robert Lankford;; Undergraduate Students - Vaishak Gopi.

Altogether, 12 principal investigators, faculty, and administrators are participating in selected projects at **North Dakota State University**: Kimberly Vachal, University Program Coordinator and PI; Andrea Huseeth , PI; Andrew Bratlien, Co-PI; Brenda Lantz, PI; Frank Yazdani, PI ; Mijia Yang, PI; Doug Benson, PI; EunSu Lee, PI; Pan Lu, PI; Denver Tolliver, Director; Donald Malchose, Project Researcher; Laurel Benson, Research Specialist. In addition, 39 graduate and undergraduate students are working on MPC projects at **North Dakota State University**.

Student	Degree	Student	Degree
Ankush Agrawal	Doctorate	Ashan Saboori	Masters
Eileen Campbell	Doctorate	Sara Mamani	Masters
Yolanda Carson	Doctorate	Hai Zhong	Doctorate
Vu Dang	Doctorate	Nathan Todd	Undergraduate
Christopher DeHaan	Doctorate	Andrew Kubas	Doctorate
Fesseha Gebremikael	Doctorate	Jaesung Choi	Doctorate
Luke Holt	Doctorate	Qianli He	Doctorate
Chijioke Ifepe	Doctorate	Nimish Dharmadhikari	Doctorate
Maher Itani	Doctorate	Hamad Al Qublan	Doctorate
Poyraz Kayabas	Doctorate	Raj Bridelall	Doctorate
Yasaman Kazemi	Doctorate	Syedia Hina	Doctorate
Dilip Mistry	Doctorate	Azadeh Jaberi	Doctorate
Elvis Ndembe	Doctorate	Jeremy Mattson	Doctorate
Ju Dong Park	Doctorate	Bryan McCoy	Doctorate

Student	Degree	Student	Degree
Yong Shin Park	Doctorate	N. Muhammad Abdul Ghan	Doctorate
Sumadhur Shakya	Doctorate	Peter Simonson	Doctorate
Napoleon Tiapo	Doctorate	Raghavan Srinivasan	Doctorate
Michael Telste	Doctorate	Robert Swearingen	Doctorate
Fangzheng Yuan	Masters	Sadar Zahid	Doctorate
Zijian Zheng	Doctorate		

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Denver** include Patrick Sherry, University Program Coordinator and PI. Graduate and undergraduate students working on MPC projects at **University of Denver** include: Doctoral Students - Keaton Zucker and Allison Bondanza; Masters Students - Rachel Mulholland.

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Colorado Denver** include: (1) Wesley Marshall, University Program Coordinator and PI; (2) Jimmy Kim, PI; (3) Carolyn McAndrews, PI; and (4) Bruce Janson. Graduate and undergraduate students working on MPC projects at **University of Colorado Denver** include: Masters Students - Alejandro Henao, Rachael Bronson, Abdul Namrou, Thushara Siriwardanage, Laia Mitchell, and Craig Fisher.

b. What other organizations have been involved as partners?

The timing of match funding and the commitments of collaborators vary widely and are still unfolding. At this time, we have the following committed collaborators.

1. AAR - John Gray, Frank Hardesty, Shannon Stare
2. AAA Foundation for Traffic Safety
3. American Association of State Highways and Transportation Officials
4. American Short Line and Regional Railroad Association - Tom Streicher, Scott Sullivan, Elizabeth Petty, and Richard Timmons
5. Avenue Consultants, Inc.
6. Buechner Institute for Governance
7. City of Madison, South Dakota
8. City of Salt Lake Transportation Division, Salt Lake City, UT
9. Colorado Department of Transportation
10. Colorado DOT Traffic Data Committee
11. Denver Regional Council of Governments
12. ND/SD Department of Public Safety, Sanford Trauma
13. Eno Foundation
14. Federal Highway Administration (FHWA)
15. Florida Atlantic University, Boca Raton, FL - Aleksandar Stevanovic, Assistant Professor; Marija Ostojic, Masters Utah Transit Authority, Salt Lake City, UT
16. Forth Berthold Reservation, ND
17. FRA Administrators
18. GCC of America (donated cement)
19. Hanson Structural Precast
20. Headwater Resources (donated Class F fly ash)
21. Kittelson & Associates, Inc.
22. LG Everest (donated aggregates)

23. Lochner
24. National Cooperative Highway Research Program
25. National Institute of Standards and Technology
26. NCAR
27. NCHRP in developing the project's ideas for a possible national-level project
28. ND Drivers Licensing Division
29. New York State Department of Transportation
30. NIST
31. North Dakota Department of Transportation
32. North Dakota Highway Patrol
33. Norwegian Public Roads Administration
34. Operation of Rural Interstates
35. Rail Transit in Denver, Colorado
36. Regional Transportation District
37. Resource Systems Group, Inc.
38. SD Department of Public Health
39. Sean Vonfeldt, Triunity (contractor of Regional Transportation District (RTD))
40. South Dakota Department of Public Safety - Marty Link, Robert Keys
41. South Dakota Department of Transportation
42. South Dakota DOT - Daris Ormesher, Aaron Breyfogle, Dustin Artz, Megan Steever
43. South Dakota LTAP - Ken Skorseth
44. Star Seismic, LLC
45. Tegracore, Industrial partner
46. Texas Department of Transportation
47. The AAA Foundation for Traffic Safety
48. University of Utah
49. Utah Department of Transportation
50. Utah Division of Wildlife Resources
51. Utah Transit Authority)
52. W.R. Grace (donated admixtures) - Mike Malherek
53. Wasatch Front Regional Council, Salt Lake City, UT
54. Washington Department of Transportation
55. West Fargo Police Department
56. Wind River Indian Reservation
57. Wyoming Department of Transportation

c. Have other collaborators or contacts been involved?

The list of collaborating organizations in 3(b) is complete, as of December 30, 2013.

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, 54 courses were offered in the fall of 2013 and 203 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. NDSU's Master of Managerial Logistics degree is now available completely online—being offered to active duty military and reserve personnel wherever they may be located. The Master of Transportation and Urban Systems degree will be offered fully online in the near future.
- 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 40 technical training events were offered in the last half of 2013. 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, MPC'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, 111 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.** Thirteen research projects have been completed thus far that address critical regional and national issues. Multiple journal articles and conference papers have been derived from each project, increasing their reach and impact. For example, a journal article derived from the MPC project on multimodal energy efficiency (b.iv) published in the Elsevier journal of Transportation and the Environment has already been accessed 247 times in 6 months. 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 2014 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

Colorado State University: PIs have indicated minor changes in some specific projects. These changes do not affect the overall goals or anticipated impact of the research program at CSU.

South Dakota State University: MPC-402 – Seismic Performance of SCC Bridge Columns and Connections. No testing of SCC joints will be performed. The project scope will be limited to columns only since the column test results showed that there would be no need to test joints.

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