

**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  
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**July 31, 2013**

**DUNS: 803882299 and EIN: 45-6002439**

**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: June 31, 2013  
Semi-Annual PPPR#3**

**Denver D. Tolliver**



**Director, Mountain-Plains Consortium  
North Dakota State University**

## 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; and (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. Other program goals are to select projects and activities using peer review principles and procedures and client input that: (1) address the Secretary's five strategic goals, and (2) leverage UTC funds with matching funds from state and local governments and private industry. The chief operational goals 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 Competitiveness, while addressing critical issues of the region and stakeholder groups.

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

#### i. Project Selection

Twenty-eight research projects for 2013 contract year have been selected and initiated through a peer review process that reflects substantial input and matching resources from state departments of transportation and MPOs in the region. Collectively, this set of projects addresses all five of the Secretary's strategic goals and several of USDOT's requested emphasis areas under State of Good Repair—e.g., (1) bridge condition monitoring, (2) locating critical infrastructure defects, (3) identifying tools to prevent and detect corrosion in transportation infrastructure, (4) analytical tools for infrastructure performance management, and (5) methods and criteria to measure performance of new materials and methods. Other research projects are related to the Secretary's strategic goals of Safety, Economic Competitiveness, Livable Communities, and Environmental Sustainability.

The projects selected under the grant are listed in Tables 1-5, under the primary strategic goal addressed by the project. Nevertheless, note that most of the projects address several goals simultaneously. In particular, many projects that address State of Good Repair have Safety and Economic Competitiveness benefits.

#### **Table 1: MPC Research Projects Most Directly Correlated with State of Good Repair**

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1. Fire performance of bridge members retrofitted with near-surface-mounted carbon fiber reinforced polymer composites
2. Impact of Energy Sector Growth on perceived Transportation Safety in the Seventeen County Oil Region of Western North Dakota: A Longitudinal Analysis
3. Local Roads Research and Outreach for Emerging High-Traffic Corridors: Phase I

**Table 1: MPC Research Projects Most Directly Correlated with State of Good Repair**

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4. Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
5. Predicting Fatigue Service Life Extension of RC Bridges with Externally Bonded CFRP Repairs
6. Re-Use of Mine Waste Materials Amended with Fly Ash in Transportation Earthwork Projects
7. Fatigue Strength of CFRP-repaired Reinforced Concrete Bridge Girders under Service Temperature
8. A Pilot Case Study to Evaluate the Potential Impact and Benefit of Adopting and Implementing BIM on Bridge and Infrastructure Projects
9. Quantifying Sustainability Metrics for Trunkline Bridges in the Mountain Plains Region
10. Framework of performance-based earthquake design of curved and skewed bridges
11. Using recycled concrete aggregate in new concrete construction
12. Structural Health Monitoring of Highway Bridges Subjected to Overweight Trucks, Phase I – Instrumentation Development and Validation
13. Implementation of Intelligent Compaction Technologies for Road Constructions in Wyoming
14. A Methodology for Developing a Replacement Strategy for County/City Owned Bridges
15. Experimental and Numerical Study for the Debonding Interface Between an Existing Pavement and a New Concrete Overlay
16. Seismically Resistant Diaphragms for Skewed And Curved Bridges Using a New Generation of Buckling Restrained Braces
17. Highway Structures Supported on Expanded Polystyrene (EPS) Embankment without Deep Foundations
18. Finding Innovative Solutions to Prevent Wildlife Access to Highways at Wildlife Guards
19. A bicycle network analysis tool for planning applications in small communities

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

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1. Impact of Energy Sector Growth on Perceived Transportation Safety in the Seventeen County Oil Region of Western North Dakota: A Longitudinal Analysis
  2. Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
  3. Finding Innovative Solutions to Prevent Wildlife Access to Highways at Wildlife Guards
  4. A bicycle network analysis tool for planning applications in small communities
  5. Development and Testing of Crashworthy Ipe Bridge Rails
  6. Connected Vehicle Weather Data for Operation of Rural Variable Speed Limit Corridors
  7. 400 South Corridor Assessment
  8. The Effect of Multi-tasking on Self-Assessments of Driving Performance Center for the Prevention of Distracted Driving
  9. Realization of a Coarse Position Verification System for an Automated Highway System
  10. Real-Time Traffic Management to Maximize Throughput of Automated Vehicles
  11. Identification of Low-Risk Adjusted Work Schedules Designed to Manage Fatigue During Peak Service Demand Periods in the Shortline Railroad Industry
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**Table 3: MPC Research Projects Most Directly Correlated with Economic Competiveness**

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1. Fire performance of bridge members retrofitted with near-surface-mounted carbon fiber reinforced polymer composites
  2. Does the Livability of a Residential Street Depend on the Characteristics of the Neighboring Street Network?
  3. Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
  4. Local Roads Research and Outreach for Emerging High-Traffic Corridors: Phase I
  5. 400 South Corridor Assessment
  6. Realization of a Coarse Position Verification System for an Automated Highway System
  7. Real-Time Traffic Management to Maximize Throughput of Automated Vehicles
  8. Identification of Low-Risk Adjusted Work Schedules Designed to Manage Fatigue During Peak Service Demand Periods in the Shortline Railroad Industry
  9. Highway Structures Supported on Expanded Polystyrene (EPS) Embankment without Deep Foundations
  10. Environmentally Benign Extraction of Bitumen from Oil Sands for Pavement Bin
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**Table 4: MPC Research Projects Most Directly Correlated with Livable Communities**

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1. Does the Livability of a Residential Street Depend on the Characteristics of the Neighboring Street Network?
2. Building a Sustainable GIS Framework for Supporting a Tribal Transportation Program
3. Local Roads Research and Outreach for Emerging High-Traffic Corridors: Phase I
4. 400 South Corridor Assessment
5. Evaluation and Development of Livability and Sustainability Programs for Indian Reservations

**Table 5: MPC Research Projects Most Directly Correlated with Environmental Sustainability**

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1. 400 South Corridor Assessment
2. Evaluation and Development of Livability and Sustainability Programs for Indian Reservations
3. Identification of Low-Risk Adjusted Work Schedules Designed to Manage Fatigue During Peak Service Demand Periods in the Shortline Railroad Industry
4. Environmentally Benign Extraction of Bitumen from Oil Sands for Pavement Binder
5. Development and Testing of Crashworthy Ipe Bridge Rails
6. Re-Use of Mine Waste Materials Amended with Fly Ash in Transportation Earthwork Projects
7. Quantifying Sustainability Metrics for Trunkline Bridges in the Mountain Plains Region
8. Using recycled concrete aggregate in new concrete construction
9. Seismically Resistant Diaphragms for Skewed And Curved Bridges Using a New Generation of Buckling Restrained Braces

## ii. Programmatic Milestones

The milestones achieved in establishing the program and meeting the required dates and guidelines were detailed in Program Progress Performance Report #1 & #2. These accomplishments are summarized in Table 6, along with additional milestones that are now underway or complete. Details associated with these added milestones are discussed in this report (Program Progress Performance Report # 2).

**Table 6: Review of Program Milestones**

<b>Milestone Event</b>	<b>Start Date</b>	<b>End Date</b>
Participation in UTC/CUTC meeting at TRB	1/12/2013	1/12/2013
Execution of grant agreement	2/15/2013	12/31/2013
Peer review of proposals	2/15/2013	4/15/2013
Publication of center directory	2/15/2013	5/13/2013
Center webpage fully operational	2/15/2013	5/13/2013
Selection of theme	2/15/2013	2/15/2013
Selection of projects	3/15/2013	6/15/2013
Posting of projects on webpage	4/15/2013	8/15/2013
Submittal of implementation plan	5/21/2013	5/21/2013
Site visit by UTC program administrators	5/30/2013	5/30/2013
Participation in UTC/CUTC summer meeting	6/10/2013	6/10/2013
Delivery of workforce development programs and activities	2/15/2013	12/31/2013
Delivery of multimodal multidisciplinary educational program	6/01/2013	12/31/2013
Conduct of multimodal multidisciplinary research program	3/15/2013	12/31/2013

## iii. Educational Accomplishments

The transportation and transportation-related courses offered during Spring & Summer 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 Thus Far**

<b>Major Subject Area</b>	<b>Course Title</b>
<b>Engineering &amp; Design</b>	Advanced Concrete Design
	Advanced Steel Design
	Engineering Surveying
	Finite Element Method
	Fundamentals of Vibrations
	Geographic Information Systems for Civil Engineers
	Geometric Design of Highways (2)
	GIS in Civil and Environmental Engineering

**Table 7: Transportation and Transportation-Related Courses Offered Thus Far**

<b>Major Subject Area</b>	<b>Course Title</b>
	GIS in Civil Engineering
	Highway and Traffic Engineering
	Highway Design
	Highway Engineering
	Infrastructure and Utility Management
	Introduction to Transportation Engineering
	Mechanics of Fatigue and Fracture
	Pavement Design (2)
	Pavement Maintenance and Rehabilitation
	Prestressed Concrete
	Professional Practice and Design
	Slope Stability and Retaining Structures
	Street and Highway Design
	Structural Analysis
	Transportation Engineering
<b>Freight &amp; Logistics</b>	Adapt Plan/Logistics Systems
	Adv Supply Chain Plainning/Enterpr
	Case Studies in Logistics
	Enterprise Recourse Planning
	Logistics Decision Analysis
	Technol Advances in Logistics
	Transportation Logistics
<b>Planning &amp; Environment</b>	Context Sensitive Solutions
	Spatial Analy/Transportation
	Transportation Planning
	Transportation Systems Modeling
<b>Public Transportation</b>	Public Transportation (2)
<b>Traffic &amp; Operations</b>	Intelligent Transportation Systems
<b>Transportation Safety</b>	Human Performance and Engineering
	Safety Simulation
	Traffic and Safety Data Analysis
<b>Transportation Systems</b>	Infrastructure and Transportation Systems
	Nuclear Material Illicit Trafficking
	Traffic Impact Assessment
	Transportation Systems II

Altogether, 46 transportation and transportation-related courses have been offered during this reporting period, 103 total transportation courses have been offered this grant period. 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.

#### **iv. Workforce Development Accomplishments**

**Training:** A list of training events provided for transportation professionals since the start of the grant is presented below.

1. 5th Annual Spring Concrete Symposium
2. DTALite/NEXTA open source software training
3. Transportation research meeting with Hill Air force Base Outreach Team, including STEM Outreach Coordinator
4. AGC Private Course
5. All about Culverts
6. Asphalt Pavement Maintenance (2)
7. ATSSA Flagger Certification(2)
8. ATSSA Traffic Control Supervisor (TCS)
9. ATSSA Traffic Control Technician (TCT)
10. Basic Concepts Of Pavement Preservation
11. Basic Surveying / Grade Checking
12. Basic Surveying Methods for Local Highway Agencies
13. Best Practice in Asphalt Mix Production for Northern Climates
14. Breaking Through the Barriers-Core Skills for Interpersonal Communication
15. Communication Skills for Supervisors
16. Concrete Preventive Maintenance-Partial Depth Repair, Diamond Grinding, & Sealing
17. Confined Space Training
18. Customer Service
19. Disadvantaged Business Enterprise-Construction Contract Provisions
20. Disadvantaged Business Enterprise-Construction Project Changes
21. EDC Exchange
22. Ethics in the Workplace
23. FHWA Bridge Preservation Guide Overview & Implementation Strategies (Webinar)
24. Full Depth Recycling-(FDR, CIR, & HIR)
25. Fundamentals of PROW ADA Ramp Design, Layout, Inspection and
26. Gravel Roads Academy (2)
27. Gravel Roads Maintenance
28. Heavy Equipment Operation (Hands On)
29. Heavy Equipment Safety Operations
30. Highway Pipe Installation-Construction & Inspection
31. Impacts of Agricultural Equipment on Highways (Webinar)
32. Integrated Roadside Vegetation Management

33. Intelligent Transportation Systems - State of Practice WYDOT, SDDOT, NDDOT
34. Introduction to Highway Construction for Engineers & Technicians (ND Only)
35. ITE Conference
36. LPA Certification
37. Maintenance of Guardrail & Safety Appurtenances
38. Managing Conflict
39. Managing Organizational Communication
40. ND Asphalt Conference
41. NHI Highway Safety Manual Practitioners Guide for Intersections
42. PE Exam Preparation for Civil Engineers (Webinar)
43. Plant Control for Warm Mix Asphalt & Recycled Asphalt Pavement (Webinar)
44. Preserving Bridge Decks-Materials Options (Webinar)
45. Registered Storm water Inspector
46. Registered SWPPP Reviewer
47. Retro reflectivity for Signs
48. Safety Edge Open House
49. Seal Coat Workshop
50. Shale Oil Exploration & Production-Impacts on Traffic & Roads (Webinar)
51. Stone Matrix Asphalt-History, Project Selection, Design & Construction Considerations
52. Street Lighting
53. Systematic Approach to Safety Management (Webinar)
54. Tractor Operator Safety: Roadside Mower Training
55. Traffic Incident Management Training: Helping to get your Partners Trained (Webinar)
56. Transportation and Safety Congress
57. Transportation Asset Management for Local Agencies
58. Tree Trimming
59. Truck Rodeo
60. Winter Road Maintenance
61. Work Zone Safety & Mobility Traffic Control Training (Supervisors)
62. Work Zone Safety & Mobility Traffic Control Training (Workers & Supervisors)
63. Workplace, Equipment & Jobsite Safety
64. Work zone Safety
65. WYDOT Aggregate Certification
66. WYDOT Asphalt certification
67. WYDOT Concrete Certification

Conferences, workshops, and publications are summarized under “products.”

**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.

Because the effective starting dates of most research projects were from mid-March to mid-April, most of the tangible results at this stage of implementation consist of workforce development and outreach activities. 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?**

No changes are foreseen to the accepted plan and implementation schedule.

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

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

**i. Key Conferences and Workshops**

**Colorado State University:**

- MPC-377: Assessing Existing Transportation Sustainability Rating Systems for use in the Mountain-Plains Consortium States. In April 2013, a conference paper was presented in the Associated Schools of Construction Annual International Conference. The paper summarized the features of six sustainable rating systems: GreenLITES, ILAST, Envision, BE2ST-in-Highways, Greenroads and Invest.

**North Dakota State University:**

- MPC-373: Damage Assessment, Characterization, and Modeling for Enhanced Design of Concrete Bridge Decks in Cold Regions Reberg, A, 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, Yazdani and Singh, Editors, 2013, pp165-169.

**University of Wyoming:**

- MPC-354: Geotechnical Limit to Scour at Spill-through Abutments (Year 2) University of Wyoming: Laboratory Investigation of Geotechnical and Hydraulic Processes during Abutment Scour. (Paper accepted, actual presentation in February 2014.)
- MPC-365: Improved Understanding of Pavement Impacts and Cost-Effective Designs Based on Mechanistic Empirical Methods Taylor Kasperick and Khaled Ksaibati, Calibration of the Traffic Distributions and Model Coefficients within the MEPDG for Local Energy-Affected Roads in Wyoming, Transportation Research Board Meeting, 2013.
- MPC-367: Developing Statistical Models for Crash Severity Comparing Statewide, County and Indian Reservation Roads Indian Reservation Safety Improvement Program: A Methodology and Case Study
- MPC-363: A Two-stage Approach for Estimating a Statewide Truck Trip Table Jansuwan, S., Chen, A. (2012) 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

### **University of Utah:**

- Ameli, M., Parks, J., Brown, D., Pantelides, C.P., Sletten, J., and Swanwick, C. (2013). Seismic evaluation of grouted splice sleeve connections for precast reinforced concrete bridge piers. 7th National Seismic Conference on Bridges and Highways: Bridge Resilience for Earthquakes & Other Natural Hazards, Paper A3-5, Eds., Kapur, J. and Ostrom, T., MCEER, University at Buffalo, State University of New York, Buffalo, New York.
- Le, T.Q. and Porter, R.J. Safety Effects of Cross Section Design on Urban and Suburban Roads, Compendium of Papers from the 92nd Annual Meeting of the Transportation Research Board, Washington, D.C., January 13-17, 2013.
- Wood, J.S. and Porter, R.J. Safety Impacts of Design Exceptions on Non-Freeway Segments, Compendium of Papers from the 92nd Annual Meeting of the Transportation Research Board, Washington, D.C., January 13-17, 2013.

### **ii. Key Presentations**

#### **Colorado State University:**

- Plankis, A. and Heyliger, P. R., Elasticity-Based Beam Vibrations for Various Support Conditions, Computers and Structures, in review.
- Hesse, Alex. Using Expert Opinion to Quantify Accuracy and Reliability of Nondestructive Evaluation On Bridges . M.S. Thesis, Colorado State University. Also, 2 journal papers have been produced based on this thesis and they are currently in review.

#### **North Dakota State University:**

- Al Wakeel, S., Kim, Y.J., Deng, Y.J. Performance of bridge decks in a cold region and a high-fidelity sensing system for damage detection, American Concrete Institute (ACI) Special Publication on Advanced Materials and Sensors toward Smart Concrete Bridges: Concept, Performance, Evaluation, and Repair (submission number-ACI-SP-MN-17) under review
- Kim, Y.J., Siriwardanage, T., Hmidan, A., and Seo, J. Material characteristics of organic and inorganic resins for CFRP composites in thermal exposure, Journal of Materials in Civil Engineering, American Society of Civil Engineers (ASCE) (submission number-MTENG-2072) under review
- Kim, Y.J. A moment-shear interaction mechanism for CFRP-strengthened RC beams, ACI Structural Journal, American Concrete Institute (ACI) (submission number-S-2013-043) under review Kim, Y.J., Hyun, S.W., Yoshitake, I., and Kang J.Y. Performance of a silyl-modified polymer adhesive for CFRP-steel interface in thermally-induced stress states, Construction and Building Materials, Elsevier (submission number-CONBUILD-D-13-01189) under review
- 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

- Mike Telste and Mijia Yang, (2013), A Deformation Distribution Based Bridge Health Monitoring Methodology, 2013 ACI congress , April 13-16, 2013, Minneapolis, MN., yes on acknowledgement of the federal support
- Ahmari, S., Yang, M.J., Impact load identification through measurement with uncertainty, Journal of Smart Materials and Structures. (accepted)

#### **South Dakota State University:**

- Xiao Qin, Zhiguang Wang. "Selection of Discount Rates for Infrastructure Investment", Interim Report, Pierre, SD, May 10, 2013
- Qin, Xiao, Cutler, Chase E. Cutler. Review of Road User Costs and Methods. SD2011-05, South Dakota State University, Brookings, 2013.
- Qin, Xiao, Cutler, Chase E. Cutler. Road User Costs Worksheet and User Manual, South Dakota State University, Brookings, 2013.

#### **University of Colorado Denver:**

- Marshall, Wesley. An Evaluation of Livability in Creating Transit-Enriched Communities for Improved Regional Benefits. Research in Transportation Business & Management, Vol. 7: 54-68, 2013.

#### **University of Wyoming:**

- Taylor Kasperick and Khaled Ksaibati, Calibration of the MEPDG for Local Roads Experiencing Heavy Truck Traffic. A paper submitted to the IJPE, **June, 2013.**  
D T Maurais<sup>1</sup>, R J Schmidt, M A Jung, Strain transfer behavior of notch-embedded fiber Bragg gratings, Journal of Civil Structural Health Monitoring, under review.
- Milliken, Eric. Improving Traveler Information on Rural Corridor in Wyoming Through the Use of Intelligent Transportation Systems. Master's Thesis. University of Wyoming. May 2013.

#### **University of Utah:**

- 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).
- 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)
- Porter, R.J. and Wood, J.S. Exploring the Endogeneity of Macroscopic Speed Parameters: Empirical Study during Low Volume Conditions in Construction Work Zones, In Transportation Letters: The International Journal of Transportation Research, Volume 5, Issue 1, 2013, pp. 27-37.

## **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/>

## **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**

Nothing to report at this time.

## **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 (Transportation Engineering)
2. Paul Barr, PI
3. Ryan Bosworth, Co-PI (applied economics)
4. Michael Thomas, Investigator (economics)
5. Rebecca Winstead, TIMELab Administrator

Students participating in MPC research projects at **Utah State University** are:

1. Ali Soltani Sobh, Ph.D. student (transportation engineering)
2. Donghyung Yook, Ph.D. Student (transportation engineering)
3. Mr. Sarawut Jansuwan, a Ph.D. student from Utah State University, who is investigating the FAF<sup>3</sup> commodity flow database.
4. Ms. Areekamol Tor. Chaisuwan, a visiting Ph.D. student from Burapha University, Thailand, who is involved in data collection efforts.
5. Conner Huffaker, graduate student

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. John Turner, PI

4. Rhonda Young, PI
5. Richard J. Schmidt
6. Robert G. Erikson
7. Hilmar L. Heininger
8. Debbie Shinstine

Students participating in MPC research projects at the **University of Wyoming** include Taylor J. Kasperick.

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Utah** are:

1. Richard Porter, University Program Coordinator and PI
2. Steven Bartlett, Associate Professor (geotechnical);
3. Evert Lawton (Co-PI), Professor (geotechnical);
4. Chris Pantelides, Professor (structures);
5. Lawrence Reaveley (Co-PI), Professor (structures);
6. Pedro Romero, Associate Professor (materials/pavements); and
7. Xuesong Zhou, Assistant Professor (transportation)
8. David Strayer, Professor, (psychology)
9. Luis Ibara, Assistant Professor (structures)
10. David Sanbonmatsu, Professor (psychology)

Graduate and undergraduate students working on MPC research projects at the **University of Utah** include:

1. Zacgary Jones (masters)
2. Charan Chandika (masters)
3. Mohammad Ameli (PhD)
4. Joel Parks (masters)
5. Dylan Brown (undergraduate)
6. Ivana Tasic (PhD)
7. Milan Zlatkovic (PhD)
8. Wade Stinson (undergraduate)
9. Zant Doty (undergraduate)
10. Anush Musunuru (masters)
11. Catherine Tucker (masters)
12. Jeffrey Taylor (masters)
13. James Coleman (masters)
14. Arwen Behrends (masters)
15. Shannon Moore (masters)
16. Heo Li (doctorate)
17. Thanh Le (doctorate)
18. Zach Gibbs (masters)
19. Shun Li (masters)
20. Jonna Turrill (masters)
21. Francesco Biondi (visiting scholar)

The principal investigators, faculty, and administrators participating in MPC projects at **South Dakota State University** are:

1. Nadim Wehbe, University Program Coordinator and PI
2. Allen Jones, PI
3. Xiao Qin, PI
4. Zhiguang Wang, PI
5. Shiling Pei, PI
6. Haifa Samra, PI

Graduate and undergraduate students working on MPC research projects at **South Dakota State University** include:

1. Brittney Ahrenstorff
2. Chase Cutler
3. Todd Pauly
4. Melissa McMullen
5. Nicole Campbell
6. Zhae Chen
7. Brett Tigges

The principal investigators, faculty, and administrators participating in selected projects from **Colorado State University** are:

1. Rebecca Atadero, University Program Coordinator and PI
2. Paul Heyliger, PI
3. Suren Chen, PI
4. Hussam Mahmoud, PI
5. Mehmet Ozbek, Co-PI
6. Caroline Clevenger, PI
7. John vande Lindt, Co-PI

Graduate and undergraduate students working on MPC research projects at **Colorado State University** include:

1. Alex Hesse (masters)
2. Paula Miller (masters)
3. Sherona Simpson (masters)
4. Kristen Peterson (masters)
5. Luke Chen (masters)
6. Maged Sales (masters)
7. Nasser Alberuti (masters)
8. Jess Quigg (masters)
9. Chris Bright (masters)

The principal investigators, faculty, and administrators participating in selected projects from **North Dakota State University** are:

1. Kimberly Vachal, University Program Coordinator and PI
2. Andrea Huseth, PI

3. Mark Berwick , PI
4. Brenda Lantz , PI
5. Frank Yazdani , PI
6. Dr. Mijia Yang, PI
7. Doug Benson, PI
8. EunSu Lee, PI
9. Pan Lu, PI
10. Denver Tolliver, Director

Graduate and undergraduate students working on MPC projects at **North Dakota State University** include:

1. Ankush Agrawal
2. Eileen Campbell
3. Yolanda Carson
4. Vu Dang
5. Christopher DeHaan
6. Fesseha Gebremikael
7. Luke Holt
8. Chijioke Ifepe
9. Maher Itani
10. Poyraz Kayabas
11. Yasaman Kazemi
12. Qing Liu
13. Dilip Mistry
14. Abdul Namrou
15. Elvis Ndembe
16. Ju Dong Park
17. Yong Shin Park
18. Andy Reberg
19. Ashkan Savori
20. Sumadhur Shakya
21. Thushara Siriward
22. Napoleon Tiapo
23. Michael Telste
24. Fangzheng Yuan
25. Shahlla Al Wakeel
26. Zijian Zheng

The principal investigators, faculty, and administrators participating in MPC projects at the **University of Denver** include:

1. Patrick Sherry, University Program Coordinator and PI.

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. Bruce Johnson, Faculty

Graduate and undergraduate students working on MPC projects at **University of Colorado Denver** include:

1. Alejandro Henao
2. Rachedl Bronson

**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. However, others may be added. Key participants from many of these organizations will be named at a later date, when their funding and personnel availability becomes more certain.

1. South Dakota LTAP: Ken Skorseth
2. South Dakota DOT: Daris Ormesher, Aaron Breyfogle, Dustin Artz, Megan Steever
3. South Dakota Department of Public Safety, Marty Link, Robert Keys
4. SD Department of Public Health
5. North Dakota Highway Patrol
6. North Dakota Department of Transportation
7. Utah Department of Transportation
8. New York State Department of Transportation
9. Texas Department of Transportation
10. Utah Transit Authority)
11. Hanson Structural Precast
12. NIST
13. Tegracore
14. Wind River Indian Reservation
15. Washington Department of Transportation
16. W.R. Grace (donated admixtures) (Mike Malherek)
17. GCC of America (donated cement)
18. Headwater Resources (donated Class F fly ash)
19. LG Everest (donated aggregates)
20. Buechner Institute for Governance
21. Colorado DOT Traffic Data Committee
22. Eno Foundation
23. ND Drivers Licensing Division
24. West Fargo Police Department
25. Wyoming Department of Transportation
26. FRA
27. ASLRRA
28. AAR
29. University of Utah
30. New York State Department of Transportation
31. American Association of State Highways and Transportation Officials
32. AAA Foundation for Traffic Safety
33. Lochner
34. Avenue Consultants, Inc.

35. Resource Systems Group, Inc.

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

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

**4. Impact**

At this time, the impact of the projects and overall program cannot be judged. Some of the PI's have commented on their specific project with projected impacts which we'd like to share.

North Dakota State University:

- MPC-372 A Novel Methodology for Quantifying the Performance of Constructed Bridges in Cold Regions, Development, Assessment, and Repair: The project will address important issues related to the infrastructure of the US, especially for the regions subjected to aggressive service conditions. It also impacts engineering education by training highly qualified personnel. More active technology transfer such as conference and workshop is expected in the near future.
- MPC-373 Damage Assessment, Characterization, and Modeling for Enhanced Design of Concrete Bridge Decks in Cold Regions: The research will address fatigue and strength issues in concrete bridge decks and will also address freeze-thaw damage in concrete in cold regions.
- MPC-374 An Integrated Real-time Health Monitoring and Impact/Collision Detection System for Bridges in Cold Remote Regions: The outcome and impact of the project will provide road and bridge agencies an easy-installation optical sensing system for collision and damage detection happened over bridges, which can improve and enhance the efficiency of bridge repair and maintenance.
- MPC-375 Small Railroad Capital Investment Needs and Financial Options: It will contribute to Congress' understanding of small railroad financing options.

University of Wyoming:

- MPC-367 Developing Statistical Models for Crash Severity Comparing Statewide, County and Indian Reservation Roads: The Indian Reservation Project resulted in helping the WRIR secure funding for multiple safety improvements.

Generalized projected impacts on the transportation industry as a whole:

- MPC projects will be performed to address vital transportation issues in Region 8 related to State of Good Repair, Economic Competitiveness, Livable Communities, Environmental Sustainability and Safety.
- Many of the research projects involve collaborative work across many disciplines to include engineers from the Civil Engineering, Industrial Engineering, Electrical Engineering, economics expert from the Economics department, psychologist from Psychology departments and many other departments across eight Universities.
- The impact on other disciplines is forthcoming when research is built into a Sustainable Transportation graduate classes that is cross-listed in Urban & Regional Planning as well as Public Policy.

- The 21st century transportation professional has been faced with challenges unlike those of previous generations, and many of our projects will be helping develop a workforce more adept at taking on these more system-wide issues.
- Results of our ongoing projects are expected to be implemented in state transportation agency policies, procedures, and practices related to road and transit infrastructure planning, design, and construction. Chances of implementation and technology transfer have been maximized by including transportation agency practitioners in the formulation and review of research problem statements. Practitioners are also providing feedback to the research teams on a regular basis through technical advisory committees formed for each project.
- Transportation Engineering has been affected by new knowledge and graduates from our programs.
- Policy and planning across our states Department of Transportations have been impacted by the new knowledge that has been created by our program.
- Technology transfer has been robust as we have been holding workshops on topics important to the transportation profession.
- A better transportation system has much broader impact on the environment and economic viability of the nation as a whole.

## **5. Changes/Problems**

No changes are foreseen 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