The theme for the Utah Transportation Center (UTC) is “Innovative Engineering Against Hazards” and comes from the core expertise of the initial group of colleagues associated with the Center. For more than a decade, the transportation research expertise within the Department of Civil and Environmental Engineering (CEE) at Utah State University has been in areas addressing natural hazards such as earthquakes, landslides, and flooding. It was decided to mold the Center around this expertise and then reach out to other colleagues to provide expertise that can be applied to both hazards and other areas of transportation.

This approach has been very successful during the first six years of the Center. In particular, the association of colleagues in Utah State University’s Department of Electrical and Computer Engineering (ECE), College of Natural Resources, Energy Dynamics Laboratory, Department of Consumer Sciences, and, most recently, the College of Agriculture, has expanded the Center’s ability to look at transportation issues from a wide variety of perspectives. Expansion of these cross-discipline partnering efforts will continue in the future.

The educational activities of the Center are centered primarily around instruction by CEE faculty associated with the Center. These faculty teach an array of transportation-related courses in many disciplines of civil engineering: surveying, structures, hydraulics, operations, transportation design, planning, and engineering economics. Center research activities focus on “State of Good Repair,” and include all transportation users. The Center’s partnerships with the Mountain Plains Consortium (MPC), Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers, and the Utah Department of Transportation (UDOT) has provided opportunities to seek solutions to today’s critical transportation needs. Our partnership with the Federal Highway Administration (FHWA) continues with work on the Long Term Bridge Performance (LTBP) Program. Work with local agencies continues through the Utah Local Technical Assistance Program (LTAP). Throughout all of our activities, the underlying emphasis on undergraduate and graduate student development continues to be a focus beyond the classroom. Students learn hands-on as they participate with Center faculty in their real-world research projects, serve local agency needs by providing technical assistance through the Utah LTAP Center, and learn from classroom instruction based on the latest in the ever-changing transportation field.

The technology transfer activities of the Center this past year have been three-pronged: (1) the presentation of papers at professional conferences—the annual Transportation Research Board meeting being the principal medium for these presentations; (2) peer reviewed journal publications (see page 8-11 for the list of presentations and publications); and (3) research dissemination to local agencies through the Utah LTAP Center.
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# Annual Report 2012-13
This past year has been successful in many ways for the Utah Transportation Center. Our partnerships with the Mountain Plains Consortium (MPC), Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers, and the Utah Department of Transportation (UDOT) has provided opportunities to seek unique solutions to today’s transportation needs. We have also been actively involved in the new University Transportation Center grant competition. We hope that this will provide opportunities to not only build on past success but also allow for new and exciting partnerships and projects.

Two projects that were partnered with UDOT were successfully completed this past year. The first was an investigation into the cracking at the abutment of an integral abutment bridge. For this study, the bridge was monitored for over a year to investigate its response due to temperature variations. This data was used to validate a finite element model that quantified the influence of span length, skew and temperature changes on stress. This project was funded through a joint partnership with UDOT and the MPC. Matching funds from the Tier 1 Center through CAIT was used to fund a second project on the development of an asset management inventory and management tools. This project not only developed an inventory of the current assets for UDOT but also provided and streamlined approach to managing these assets. The Utah Department of Transportation continues to be a valued partner for the Utah Transportation Center.

Due, in part, to the success to the faculty and students in the Utah Transportation Center we were provided an opportunity to hire an additional faculty member. I am please to announce that Dr. Marc Maguire will be joining the faculty in the Civil and Environmental Engineering Department at Utah State University in the fall. Dr. Maguire received his PhD from Virginia Tech and will be a valued asset to the department and the Utah Transportation Center.

Last but certainly not least, student education continues to be a primary focus of the Center. The center supported Wesley Cook with a fellowship to work on his PhD. Mr. Cook is currently looking at not only the probability of failure along the nations infrastructure but also the consequence
of that failure. He was selected as our University Transportation Center Student of the Year and received his award at TRB where he also presented a paper on his research. We were also proud to support Kailey Jackson to travel to this years Women in Transportation conference in Pittsburgh, Pennsylvania.

We look forward to continuing to grow our partnerships during the upcoming year. The faculty and students that are working with the Utah Transportation Center have many new and exciting projects. The University Transportation Center Program has provided many unique opportunities and we look forward to what the future holds.

**Highlights & Happenings**

**INTERDISCIPLINARY APPROACH EARN COLLEAGUES A GRANT TO STUDY NATURAL GAS AS A TRANSPORTATION FUEL**

Two Utah State University assistant professors, Dr. Kevin Heaslip (Civil and Environmental Engineering) and Dr. Ryan Bosworth (Applied Economics), have joined forces across departmental lines to work on a grant to study the implications of lower natural gas prices on the transportation industry.

Funded by the Washington State Department of Transportation (WSDOT), the project began in May 2012. The initial award of $100,000 was awarded for research into the economics behind the shift to natural gas as a fuel. The Mountain Plains Consortium then awarded a match, giving Utah State University a total of $200,000 for the project.

The grant was awarded as part of a nationwide competition, which attracted proposals from major research universities from all parts of the country. However, the interdisciplinary approach taken by Dr. Heaslip and Dr. Bosworth, gave USU the edge over their competition.

The goal of this research is to increase the understanding of the implications of an increase in natural gas availability in Washington State and how it will affect their transportation system. The research effort is designed to help transportation planners understand under what conditions natural gas will be an economically viable alternative to traditional transportation fuel.

“Part of the reason for that is the lower price of natural gas,” stated Heaslip. “Because it is being used more, the question we are hoping to answer is--what are the implications of [natural gas fuels] going to be?”
WSDOT is interested in the possibilities of making natural gas more readily available as a transportation fuel and what impact that will have on state fuel tax revenues. Approximating the changes in Green House Gas Emissions is another major concern that is being addressed by this research.

“Currently, natural gas is less expensive than the gasoline per gallon equivalent,” said Bosworth. “However, natural gas vehicles are more expensive to purchase.” “There are other drawbacks to the use of natural gas as a fuel for passenger cars as well, such as reduced fuel capacity and fewer fueling stations.”

These factors, in addition to the infrastructure constraints, will greatly influence the number of people who operate natural gas vehicles.

“This project will help us establish through interdisciplinary actions an alternative,” said Heaslip. “Working with electric and natural gas vehicles is what we do here at USU engineering and we are really focusing on building a name for USU through completion of this project.”

Excerpt from the article titled, “College of Engineering and College of Agriculture Receive Grant to Study Natural Gas as a Transportation Fuel,” by Sarah Hatch, Utah State University, College of Agriculture

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**Utah LTAP—25 Years Strong**

The Utah LTAP Center is celebrating 25 years of bridging the gap between research and practice! Since its inception in 1988, the Utah LTAP Center (first called the Utah Technology Transfer (T²) Center) has been translating the latest state-of-the-art technology in transportation into implementable products and information for the special use of local transportation agencies and personnel. Six years ago they strengthened their mission by becoming part of the Utah Transportation Center.

As an integral part of the nationwide Local Technical Assistance Program (LTAP)—financed by the Federal Highway Administration, state departments of transportation and local transportation agencies—they have built on a solid foundation of practical research aimed at making the latest technological innovations more accessible to local transportation agencies.

This work is conducted in a variety of ways:

- training on critical transportation issues and developments
- a quarterly newsletter highlighting the latest developments and innovations in transportation
- technical assistance to help local agencies directly implement best-practices and cost-saving technology
- special projects to meet the needs of local agencies in a cost-efficient manner
- partnerships with national, state, and local organizations to expand the services available
for local agencies (i.e. APWA, NACo, ATSSA, ITE, etc.)

To give you a picture of just what that means for the local agencies and personnel in the State of Utah, here are a few numbers.

Since 2006 when the most accurate records have been kept:
• More than 103,000 instruction hours were provided, for
• More than 15,000 students
• In nearly 950 courses!

That has been accomplished with a minimal staff of dedicated professionals (3 full-time), and the services of college-level engineers-in-training, as well as select on-call instructors with critical field experience.

Over the last 25 years, the Utah LTAP Center has meet regularly with their Advisory Board, and their local agency customers, to determine the most critical areas of need, and the best way to help local agency personnel meet those needs. The focus has been organized into four areas:
• Safety
• Workforce Development
• Infrastructure Management, and
• Organizational Excellence

Safety has been consistently the biggest focus with more than 50% of LTAP workshops taught and more than 50% of LTAP budget expenditures earmarked to meet that need. With the many developments in the area of safety, and the increase in litigation related to unsafe roadway conditions, local agencies are looking to the LTAP Center to help find ways to improve safety on critical local roadways. They are also under pressure to address safety concerns from the Federal level and the Utah LTAP Center is at the forefront in efforts to share and help them implement cost-effective solutions to safety issues.

By working to meet needs in these critical areas, the Utah LTAP Center has not only been able to effectively serve the vital needs of local agencies, but to do so within tight budgets.
Dr. Patricia Cramer, Center colleague and Utah State University (USU) researcher in the Department of Wildland Resources, was honored this summer with the FHWA 2013 Environmental Excellence Award for Research. She received the award in Virginia Beach at the Annual Meeting of the American Association of State Highway Transportation Officials (AASHTO), Standing Committee on the Environment.

The competition was nationwide, with dozens of projects in the running, all from very different types of environmental research related to transportation.

Dr. Cramer’s colleagues on the collaborative project were also honored. These colleagues came from USU, the Utah Department of Transportation and the Utah Division of Wildlife Resources:

**Utah State University**
- Robert Hamlin
- Megan Schwender (UTC-supported graduate student)
- Dr. Kevin Womack (former UTC director, now with the US-

**Utah Department of Transportation**
- Monte Aldridge
- Chet Johnson
- Shane Marshall
- David Stevens
- Rebecca Stromness
- Randall Taylor
- Paul West
- Brandon Weston

**Utah Division of Wildlife Resources**
- Bruce Bonebrake
- Rhett Boswell
- Ashley Green
- Pam Kramer
- Doug Sakaguchi

The project, titled “Wildlife Crossing in Utah: Determining What Works and Helping to Create the Best and Most Cost-Effective Structure Designs,” is a statewide project, titled “Wildlife Crossing in Utah: Determining What Works and Helping to Create the Best and Most Cost-Effective Structure Designs.”
environmental research study led by Dr. Cramer, with the support of the Utah Department of Transportation and the Utah Division of Wildlife Resources. The study monitored wildlife use of wildlife crossing culverts and bridges, and existing structures, to craft design recommendations aimed at reducing wildlife-vehicle collisions statewide.

The study used camera traps across Utah to observe wildlife reactions at 38 structures, 15 of which were specifically designed wildlife crossing culverts and bridges, in order to determine the best designs for passing mule deer, elk, moose, and other wildlife under and above roads. The project’s recommendations, such as ideal culvert lengths and optimum wildlife exclusion fencing design, have become part of Utah’s standard operating procedure for wildlife crossings. By investigating ways to reduce wildlife-vehicle collisions, the study stands to offer the State of Utah substantial cost savings in the coming years.

Beyond the State’s borders, the project enhances state-of-the-practice knowledge of transportation’s effects on the natural environment across the country. This research project continues to advance tools to support integrated approaches for transportation decision making, including new methods for wildlife monitoring and best practices for the design and placement of wildlife crossing structures. The environmental research efforts of Dr. Cramer and USU and their partners demonstrate the practicality of incorporating wildlife considerations into the transportation planning process.

The project further illustrates that, even with diverse backgrounds and approaches, transportation and environmental considerations can both be addressed in a way that safeguards not only the traveling public, but our shared wildlife resources as well.


**Center Names Student of the Year—Wesley Cook**

The Utah Transportation Center is pleased to announce the selection of Wesley Cook as the Student of the Year!

Wesley was raised in Las Cruces, New Mexico. In high school he excelled in cross country and choir. He received a full-ride academic scholarship to New Mexico State University (NMSU), where he participated in ASCE steel bridge competitions and worked at the NMSU Center of Transportation and Research performing bridge inspections, graduating in 2006. His experiences at NMSU solidified his desire to conduct research related to bridges.

After graduation, he worked as a consultant at Forsgren Associates, Inc. for three years. In 2010, he completed an MS in structural engineering at Utah State University, focusing his research on full-scale destructive testing of bridge sections that were constructed with an accelerated bridge construction technique (thesis).

His latest work (dissertation) determines epistemic risk of bridge failures from historical data which quantifiably defines the probability of bridge failures. This work has potential to transform vulnerability bridge assessments.

He is interested in expanding upon risk assessment with individual cause of failure probabilities, consequences, and consideration of predictors.

Mr. Cook was nominated to this year’s student of the year for his interdisciplinary research achievements and commitment to improved bridge management systems.

He is also a licensed engineer in Utah and is married with two daughters. Congratulations Wesley, on this well-deserved honor!
NEW PROJECTS

UTC-Tier 1 CAIT-1201 “Bridge Response Due to Temperature Variations,” Dr. Paul J. Barr, PI. Funded by Tier 1 CAIT at USU.

UTC-Tier 1 CAIT-1202 “Forensic Testing of Prestress Concrete Girders after Forty Years of Service,” Dr. Paul J. Barr, PI. Funded by Tier 1 CAIT at USU.


UTC-MPC-1202 “A Bicycle Network Analysis Tool for Planning Applications in Small Communities,” Dr. Anthony Chen, PI. Funded by the Mountain-Plains Consortium.


ONGOING PROJECTS

UTC 1201 “Forensic Testing of Prestressed Girders,” Dr. Paul J. Barr, PI. Funded by Tier 1 CAIT at USU.

UTC 1202 “Accelerated Bridge Construction Deck Testing,” Dr. Marv W. Halling, PI. Funded by Tier 1 CAIT at USU.

UTC 1203 “Sign Management,” Dr. Kevin Heaslip, PI. Funded by Tier 1 CAIT at USU.

UTC 1204 “A Two-Stage Approach for Estimating a Statewide Truck Trip Table,” Dr. Anthony Chen, PI. Funded by the Mountain-Plains Consortium.


UTC 1204 Develop Design Guidelines for Integral Abutment Bridges,” Dr. Paul J. Barr, PI. Funded by the Mountain-Plains Consortium.

COMPLETED PROJECTS

UTC 0703 “Strong Motion Instrumentation Plan for UDOT Bridges: Array Design, Typical Details, and Specifications,” Dr. Marvin Halling, PI. Co-funded by UDOT and UTC.

UTC 0704 “Failure Modes Analysis of UDOT’s MSE Wall Inventory,” Dr. James Bay, PI. Co-funded by UDOT and UTC.

UTC 0705 “Logan Bluff Landslide Risk Analysis,” Dr. Robert Pack, PI. Funded by UDOT.

UTC 0706 “Wireless Broadband for Commuter Rail: ‘River of RF’,“ Dr. Chris Winstead, PI. Funded by UTC.
UTC 0801  “Development of a Decision Support Tool for Assessing Vulnerability of Transportation Networks,” Dr. Anthony Chen, PI. *Co-funded by UDOT and UTC.*

UTC 0802  “Synthesis Study and Field Evaluation of In-Situ Culvert Rehabilitation in Utah,” Dr. Blake Tullis, PI. *Co-funded by UDOT and UTC.*

UTC 0803  “ABC Deck Connections, Laboratory Testing and Evaluation,” Dr. Marvin Halling, PI. *Co-funded by UDOT and UTC.*

UTC 0804  “Investigation of the Use of Texel Cameras for Counting Passengers on Public Transportation,” Dr. Scott Budge, PI. *Funded by UTA.*

UTC 0805  “Shear Capacity of Pre-stressed Girders,” Dr. Paul Barr, PI. *Co-funded by UDOT and UTC.*

UTC 0901  “Long Term Bridge Performance Program, Supplemental Funding, Year 1,” Dr. Marvin Halling, PI. *Funded by UTC and FHWA.*

UTC 0902  “Cache Valley Transit District (CVTD) Rider Surveys and Analyses,” Dr. Kevin Heaslip, PI. *Funded by the CVTD.*

UTC 0903  “Cache Metropolitan Planning Organization (CMPO) Traveler Preference Study,” Dr. Kevin Heaslip, PI. *Funded by the CMPO.*

UTC 0904  “Quality of Life in Cache Valley Study,” Dr. Kevin Heaslip, PI. *Funded by UTC.*

UTC 1001  “Work Zone Design Evaluation,” Dr. Kevin Heaslip, PI. *Co-funded by UDOT and UTC.*

UTC 1002  “Forecasting Network Traffic for Small Communities in Utah,” Dr. Anthony Chen, PI. *Funded by UTC.*

UTC 1003  “Highway Wildlife Crossing Design Study,” Dr. Patricia Cramer, PI. Funded by UTC. “UDOT’s Calibration of AASHTO’s New Prestress Loss Design Equations,” Dr. Paul Barr, PI. *Co-funded by UDOT and UTC.*

UTC 1004  “Investigation of the Use of Texel Cameras for Counting Passengers on Public Transportation, Phase II,” Dr. Scott Budge, PI. *Funded by UTC.*

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**2012-13 Presentations & Publications**

**Presentations & Conference Proceedings**

*listed alphabetically by lead author; Utah Transportation Center colleagues in bold*


**Publications (Journal Papers)**

listed alphabetically by lead author; Utah Transportation Center colleagues in bold


**FUNDING BY SOURCE**

*Total budget for FY2013: $1,117,000 (includes funds from all sources)*

- **USDOT/RITA (48.1%),** $537,000.00
- **UDOT (25.1%),** $280,000.00
- **USU (14.7%),** $164,376.00
- **Private Corporations (8.6%),** $95,624.00
- **Special State Appropriations (3.6%),** $40,000.00
- **University F&A (20.4%),** $227,868.00
- **Research (59.3%),** $662,381.00
- **Education (11.1%),** $123,987.00
- **UTC Administration (6.3%),** $70,371.00
- **Scholarship (2.9%),** $32,393.00

**FUNDING BY USE**

*includes all funds expended and encumbered during FY2013*
The Utah Transportation Center is housed in the Civil & Environmental Engineering Department in the College of Engineering, on the campus of Utah State University in Logan, Utah.