Program Progress Performance Report for University Transportation Centers

Submitted to: Office of the Assistant Secretary for Research and Technology
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Federal Grant Number: DTRT13-G-UTC49

Project Title: Tier 1 University Transportation Center for Environmentally Sustainable Transportation in Cold Climates (CESTiCC)

Program Director: Dr. Jenny Liu, P.E., Associate Professor in Civil Engineering
Email: jliu6@alaska.edu; Phone: 907-474-5764

Submission Date: April 30, 2015

DUNS Number: 615245164

EIN Number: 92-6000147

Recipient Organization: University of Alaska Fairbanks
PO Box 755900, Fairbanks, AK 99775-5900

Project Grant Period: September 30, 2013- September 30, 2018

Reporting Period End Date: March 31, 2015

Report Term: Semi-annual PPPR #3

Signature: [Signature]
1. Accomplishments

What are the major goals and objectives of the program?

The major goals and objectives of the CESTiCC program are to systematically engineer environmentally sustainable transportation infrastructures in cold climates, considering the entire life cycle of transportation planning, design, materials selection, construction, maintenance and operations, preservation, and recycling through the collaboration of academia, industry and other stakeholders by cross-disciplinary research, education, and technology transfer activities.

What was accomplished under these goals?

During the past six months of the project:

- **Regular email announcements and website updates**
  A CESTiCC emailing contact list was created categorized by partners, friends, US DOT officials, the advisory board, peers, UTCs, researchers and students, etc. We update this contact list very frequently. The Center announcements have been distributed through emails and then forwarded to professionals in the transportation and engineering communities by CESTiCC partners such as the Environmental UTC Network, Infrastructure & Climate Network, TRB committees, ASCE committees, DOTs’ Research, Development, & Technology Transfer section, etc. Center activities have been posted to the website in a timely fashion as reflected by *News, Webinars*, and other links on the CESTiCC website.

- **Monthly webinar series**
  Starting in September 2014, CESTiCC has hosted monthly webinar series that invites internationally recognized researchers to discuss *Environmentally Sustainable Transportation in Cold Climates*. The seminar series is free and open to all transportation professionals and engineering communities. Since the last reporting period we have hosted five webinars including “Climate Adaptation and Scenarios: Planning for the Built Environment”, “An Automated System for Rail Transit Infrastructure Inspection”, “Sustainability Practices in Highway Winter Operations”, “Recent Advances and users of RCC in the United States” and “High Content Recycled Asphalt Pavement up to 100% Recycling”.

- **E-newsletters**
  Starting in December 2014, CESTiCC has sent out E-newsletters. The newsletters give our subscribers the opportunity to see what we have been up to and any upcoming events. We have published three newsletters during the reporting period and pdf files of each newsletter can be found on the CESTiCC website.
Research projects
CESTiCC has funded fourteen research projects. Twelve were set up at the beginning of the reporting period, and two more were added in the fall. These projects cover all five research thrusts of the Center, and they are:

1. Development of Guidelines for Synthetic Fluid Dust Control Palliative Application
2. A Bio-Wicking System to Prevent Frost Heave in Alaskan Pavements
3. Characterization of Alaskan Hot-Mix Asphalt Containing Reclaimed Asphalt Pavement Material
4. Sustainable Construction in Remote Cold Regions
5. Modeling Impacts of Cold Climates on Vehicle Emissions
6. Transportation Life Cycle Assessment (LCA) Synthesis
7. Impact of Cold Climates on Vehicle Emissions: Cold Start Air Toxics Pulse
8. Environmentally Friendly Pervious Concrete for Treating Deicer-Laden Stormwater
9. Recent Advances in Sustainable Winter Road Operations
10. Bio-based Renewable Additives for Anti-Icing Applications
11. The Stormwater - Pavement Interface in Cold Climates
12. Life Cycle Sustainability Assessment of Highway Winter Maintenance
14. Optimal Highway Durability in Cold Regions

The research progress during this reporting period is summarized as follows.

- All fourteen research projects have been entered into the RIP database.
- Quarterly reports have been collected and reviewed in a timely fashion to keep track of progress, accomplishments and future goals.
- PIs continue to disseminate research results through professional meetings and other venues, and details can be found in the products section on pages 8 -11 of the PPPR.
- Dr. Xianming Shi’s research on environmentally friendly winter maintenance has been picked up by journalists all over the nations. Most notably, they are Los Angeles Times, CBS News, H2O Radio, Storm water Report, The Courier Journal, Vox, American Ceramic Society, KLEW TV, Washington Times, Transportation Research Board, USA Today, Scientific American, Daily Evergreen, Munchies, NPR, Moscow-Pullman Daily News, Spokane Channel 2 TV, TreeHugger.com, Time.com, WSU news, and Discovery Magazine. The Center also provided an article for the DOT April newsletter
- PIs are continuing with their research and details can be found in the products section on pages 8 – 11 of the PPPR.
- The first modules in the Environmental Life Cycle Assessment learning Module Series are now available on the CESTiCC website. The modules are in PowerPoint format with narration and will automatically play the audio and advance slides when put in presentation mode. Each module is approximately
twenty minutes long. They are intended to be used for personal education, short background workshops or as components for more detailed classes.

- **International Symposium**
  CESTiCC is hosting the International Symposium on Systematic Approaches to Environmental Sustainability in Transportation (ISSAEST) to be held on August 2-5, 2015, at the University of Alaska Fairbanks. To date, ISSAEST has attracted extensive attention from a wide variety of research areas addressing environmental sustainability in transportation infrastructure. A total of 106 abstracts were submitted for presentation in the symposium to discuss the timely topics within these areas. A total of 59 technical papers were reviewed and accepted for publication in the symposium proceedings (two ASCE Special Publications, EI indexed). The preparation of ISSAEST is in progress and updates are posted in the symposium's website regularly. The tentative program was made available in early April.

- **Effective communication and exchange**
  Meetings with state agencies, industry experts, private sectors, and other institutions were held to discuss ideas and collaborate on research, education, workforce development, and outreach activities. A Gotomeeting with CESTiCC Advisory Board was held in November to report the program progress and receive comments and feedback from advisory board members. CESTiCC also hosted a research collaboration meeting with partner agencies in December to identify critical environmental sustainability related transportation issues deserving research and develop new research need statements for Year Two research.

- **Sponsorship**
  CESTiCC sponsored a number of events during this reporting period to promote the UTC program. On November 24th and 25th, Alaska DOT&PF and CESTiCC hosted the 2014 Concrete Summit: “Economical Innovations for Extended Service Life” in Anchorage, Alaska. CESTiCC played an active role during the 94th TRB Annual Meeting by co-hosting a reception with PacTrans and actively supporting UTC related activities. CESTiCC also sponsored the UAF Concrete Canoe team to help their efforts to design an environmentally sustainable concrete canoe. The team won 4th place at the competition in Idaho for their 2nd year.

- **Outreach and technology transfer**
  CESTiCC has actively participated in various outreach activities and technology transfer to promote environmental sustainability in transportation. Please see details in the what opportunities for training and professional development on page 5, how have these results been disseminated section on pages 5 – 7 and the Impact section on page 13.
What opportunities for training and professional development has the program provided?

- CESTiCC is hosting three visiting professors (Drs. Rongtao Yan, Zhibing Wang, and Zhaotian Zeng) from Guilin University of Technology, Guilin, China. They are working with Dr. Xiong Zhang’s group on research topics on modeling and monitoring soil behavior for environmental considerations.
- CESTiCC provided funding for Quinn Langfitt, CESTiCC Student of the Year, to attend the 94th TRB annual meeting.
- CESTiCC researchers, Laura Fay and Xianming Shi presented on “Strategies to Mitigate the Impacts of Chloride Roadway Deicers on the Natural Environment” for a TRB Webinar on December 17, 2014.
- On October 28, 2014, CESTiCC and Infrastructure & Climate Network (ICNet) co-hosted a webinar on “Climate Adaptation and Scenarios: Planning for the Built Environment” presented by Dr. Paul Kirshen.
- On November 22, 2014, Drs. Jenny Liu, Yuanchang Xie and Tian Xia gave a webinar on “An Automated System for Rail Transit Infrastructure Inspection”.
- On February 03, 2015, Dr. Xianming Shi gave a talk on “Sustainability Practices in Highway Winter Operations: A Renewed Perspective”.
- On March 10, 2015, CESTiCC invited Mr. Corey Zollinger from CEMEX USA to give a webinar on “Recent Advances and uses of RCC in the United States”.
- Dr. Liv Haselbach presented on low impact development (LID) and pervious concrete to a group at the Institute for Water Resources as the Federal University of Rio Grande do Sul (UFRGS) in Porto Alegre Brazil on March 20th, 2015. 15 students attended and two public officials from the city attended. In addition, Dr. Haselbach has been training approximately ten undergraduate students in the civil engineering department at UFRGS in laboratory techniques for researching pervious concrete.

How have the results been disseminated? If so, in what way? (Please provide links or examples for website use.)

CESTiCC staff and researchers have been actively involved in various professional meetings and outreach activities to promote the UTC program, enhance public understanding and increase interest in learning and transportation careers.

- Presentations and invited talks
  During this reporting period CESTiCC members have given numerous presentations and invited talks at various professional venues all over world such as:
  1. Transportation Research Board Webinar
  2. International Erosion Control Association Conference
  3. ASCE LID Conference
  4. Washington State University Academic Showcase
  5. The 5th International Association for Chinese Infrastructure Professionals Annual Workshop
  6. 94th Transportation Research Board annual meeting
8. Institute of Water Resource Research at the Federal University of Rio Grande do Sul
9. 2015 ASCE Construction Institute Summit Meeting
10. Washington State Association of Counties
11. LCA Pavement Conference
12. PacTrans Conference
13. Green Chemistry Roundtable

For more details please review the product section found on page 8 – 11.

• **Research information through RiP, website, quarterly reports, and Gotomeetings**
  Research project information was available at the TRB’s Research in Progress (RiP) database and the Center’s website. Research progress was updated to funding agencies through quarterly reports and Gotomeetings.

• **University of Alaska Fairbanks Arctic Day, November 13, 2014**
  The Arctic Day provided an opportunity for UAF and the community to gather, display, and discuss topics in research and teaching that occur in the Arctic area. CESTiCC displayed its research highlights and outreach initiatives.

• **KIAK 102.5 FM and KFBX AM 970 Radio Interviews, December 10, 2014**
  CESTiCC Director Jenny Liu and Program Assistant Melissa Sparks were invited to discuss environmentally sustainability in transportation infrastructure and promote CESTiCC’s mission on the radio.

• **Museum of Science, Boston, MA January – February, 2015**
  CESTiCC Associate Director at MSU, Laura Fay aided in the development of an interactive exhibit on “Road Salt use in the U.S.” that is on display at the Museum of Science, Boston, MA.

• **Pearl Creek Elementary STEM Night, February 5, 2015**
  CESTiCC Director Dr. Jenny Liu and CESTiCC staff Melissa Sparks and Dr. Sheng Zhao volunteered at the Pearl Creek Elementary annual STEM Night. The Fairbanks community came together to provide hands on STEM experiences for elementary students. CESTiCC offered instruction on levers, pulleys and fractions. Students had the opportunity to see firsthand how levers and pulleys operate. In addition, students were able to learn fractions through three-dimensional shapes to help the students grasp fraction concepts more easily.

• **Engineering Open House, February 28, 2015**
  Each year UAF College of Engineering and Mines hosts an engineering open house for the Fairbanks community. The open house takes place in conjunction with National Engineers Week, an annual event to increase public awareness and appreciation of engineers and their work. On February 28th, more than 900 people came out for the open house. CESTiCC created a hot wheels derby for kids to experience transportation in an exciting way! Each child was given the opportunity to
push the race car down the tracks and observe how the race car performed in different circumstances. Parents and children were also able to observe the layers that make up a road through a visual display built by undergraduate student, Paul Eckman.

- **Major Mania at UAF, March 27, 2015**
  On March 27th, CESTiCC had the opportunity to meet with high school seniors and college freshman to discuss transportation engineering as a career choice at Major Mania. The event, hosted by the Academic Advising Center at the University of Alaska Fairbanks, gave prospective and current students the opportunity to learn about the 160+ programs UAF offers. Students were able to connect with faculty, staff and fellow students from the majors that interested those most.

**What do you plan to do during the next reporting period to accomplish the goals and objectives?**

We will follow the implementation plan to ensure that all the CESTiCC funded research, education, and outreach activities move forward as scheduled.

- CESTiCC will select new research projects for Year Two research.
- Project progress update meetings will be held for all CESTiCC on-going projects. PIs will report on the status of their research to funding agencies.
- CESTiCC researchers will continue to get students involved in research and disseminate results timely.
- CESTiCC will continue monthly webinar series by working with various partners. The seminar series will be open to all transportation professionals and presentations will be posted on the Center’s website after the seminar.
- CESTiCC will continue to participate in various activities on outreach, technology transfer and other activities to publicize the Center.
- The website will continue to be updated with news, products and research. We will also continue producing our E-newsletter, which will then be posted on our website in pdf format.
- Summer Transportation Institute, June 8 -12, 2015.
  CESTiCC will be co-hosting the Summer Transportation Institute with Alaska Tribal Technical Assistance Program Center and the Alaska Local Technical Assistance Program Center from June 8-12, 2015. This 5-day training workshop will engage participants in lectures, lab tours, and field trips with various topics on transportation infrastructure in a rural and cold environment. This program will provide training certificates and professional development hours to participants.
- International Symposium on Systematic Approaches to environmental Sustainability in Transportation (ISSAES), August 2 – 5, 2015.
  The ISSAEST will be held on August 2-5, 2015, at the University of Alaska Fairbanks. The symposium was organized by CESTiCC with co-sponsorship from Transportation Research Board and ASCE Construction Institute. The symposium aims to provide a forum for professionals to discuss environmental challenges associated with design, construction, and maintenance of multimode transportation
systems. It will also serve as a showcase of recent development, practices, and advances to maximize environmental sustainability. The symposium will include workshops, key note speeches, technical sessions and field trips such as a Geothermal renewable energy tour, permafrost tunnel, and Beaver Slope field site trips.

2. Products

Publications, conference papers, presentations, websites, lectures, seminars, workshops, invited talks

- Publications
  - C. Lin, J. Liu, and X. Zhang, *Development of Innovative Antifreeze Grout Mortar for Anchor Applications in Cold Regions*, Transportation Research Record: Journal of Transportation Research Board (accepted), 2015.
  - Li, L. and Zhang, X. “Evaluate Shear Strength of an Unsaturated Soil using Modified Unconfined Compression Test.” Transportation Research Record: Journal of the Transportation Research Board (accepted), 2015.
Presentations

- **Fay, L. Strategies to Mitigate the Impacts of Chloride Based Deicers to the Environment.** International Erosion Control Association (IECA) Environmental Connections, February 18, 2015 Portland, Oregon.
- Dr. Xianming Shi's PhD student Gang Xu presented his research entitled, *Environmentally Friendly Mortars with Coal Fly Ashes as Cementitious Binder* at WSU Academic Showcase on March 27th, 2015.
- **Cui, N. and Shi, X. Improved User Experience and Scientific Understanding of Anti-icing and Prewetting for Winter Maintenance in North America.** 94th TRB annual meeting, Washington DC, January 2015.
- **Shi, X. Snow and Ice Control Environmental BMPs.** 94th TRB annual meeting, Washington DC, January 2015.
- **Li, L. and Zhang, X. A Modified Unconfined Compression Testing System to Characterize the Stress-Strain Behavior of Unsaturated Soils at Low Confining Stresses.** 94th TRB annual meeting, Washington DC, January 2015.
- **Zhang, X. and Li, L. Experimental Study of Total and Localized Volume Changes of Unsaturated Fairbanks Silts under Undrained Loadings.** International Foundations Congress and Equipment Expo 2015, San Antonio, TX, March 2015.
- Haselbach, L. Pervious Concrete in Pullman and Carbon Sequestration in Old and New Portland Cement Concrete Pavements. 94th TRB annual meeting, Washington DC, January 2015.
- Landfitt, Q and Xu, G. Coupled Oil Analysis Trending and Life-Cycle Cost Analysis for Vessel Oil Change Interval Decisions and Environmentally Friendly Mortars with Coal Fly Ashes as Cementitious Binder. 94th TRB annual meeting, Washington DC, January 2015.
- Haselbach, L. Metal uptake by Pervious Concrete. LCA Pavement Conference at UC Davis, October 2014.
- Haselbach, L. Metal uptake by Pervious Concrete. PacTrans Conference, October 2014.

Other Products (CESTiCC in the News)
- Putting the Crosshairs on Deadly Crossings, Bugle Magazine, April 2015
- Road Salt is Polluting our Rivers. WIRED. Gwen Pearson. Published March 12, 2015.
- Safe Passages. Mountains & Minds, the Montana State University Magazine. Sepp Jannotta. Published 10/13/14.
- How America got addicted to road salt – and why it’s a problem. VOX. Brad Plumer. Published January 26, 2015.
- Greener deicers and smarter snowplows could equal less bucks for state budgets. The American Ceramic Society. Jessica McMathis. Published January 8, 2015.
• *Road De-Icing Researchers Say Hold The Salt, Pass The Vodka By-Product.* NPR. Jessica Robinson. Published November 26, 2014.

• *Scientist are Melting Road Ice with Vodka and beet Juice.* Munchies. Hilary Pollack. Published November 30, 2014.


• *WSU mixes green alternatives to chemical de-icers.* KREM2. Briana Bermensolo. Published November 24, 2014.


• *Green Highway Snow and Ice Control Cuts the Chemicals.* Infrastructure USA. Published November 24, 2014.

• *Salt shortages: States find it tough with winter storms, icy roads.* LA Times. Paresh Dave. Published February 5, 2014.


**Websites**

• Green Winter Maintenance in the News: https://sites.google.com/site/greensmartinfrastructure/news

• LCA Education Module: cem.uaf.edu/cesticc/publications/lca.aspx

• CESTiCC Website: http://ine.uaf.edu/cesticc/

• CESTiCC Facebook Page: https://www.facebook.com/cesticc

• CESTiCC Radio Interview: www.970kfbx.com/media/podcast-whats-up-at-uaf-UAFUpdate/uaf-northern-engineering

**Lectures/Seminars/Workshops/Invited Talks**


• Invited webinar. “Use of Wicking Fabric to Dehydrate Road Embankment under Unsaturated Conditions” by Xiong Zhang, an invited webinar to graduate students taking CE580/600 at Washington State University, March 2nd, 2015.

3. Participants & Collaborating Organizations

What organizations have been involved as partners?

- **Collaborative** research and financial support
  Fourteen research projects were selected and funded by CESTiCC and the following agencies:
  - Alaska Department of Transportation and Public Facilities
  - Minnesota Department of Transportation
  - Nevada Department of Transportation
  - Washington State Department of Ecology
  - Clear Roads Pooled Fund
  - TenCate Geosynthetics
  - Midwest Industrial Supply, Inc., Canton, OH
  - Montana Department of Transportation

Have other collaborators or contacts been involved?
Tele-conferences and GoTo meetings were held during the reporting period to discuss research ideas and broad collaborations on research, education, workforce development, and outreach activities between CESTiCC and various collaborators:

- Research collaborators:
  - Apun LLC, Anchorage, AK
  - Alaskans for Litter Prevention and Recycling (ALPAR)
  - Insulfoam
  - Central Environmental Inc.
  - University of Tennessee, Knoxville
  - Brookings Institution

- Education and outreach collaborators:
  - Alaska Tribal Technical Assistance Program Center
  - Alaska Local Technical Assistance Program Center
  - Environmental UTCs Network
    - CESTiCC
    - National Center for Sustainable Transportation
    - Marine Engine Testing and Emissions Laboratory
    - Electric Vehicle Transportation Center
    - Mid-Atlantic Transportation Sustainability (MATS) Center
  - PacTrans
  - Infrastructure & Climate Network (ICNet)
  - Louisiana Transportation Research Center

- Collaborators for organizing International Symposium:
  - ASCE Construction Institute
  - University of Kansas
  - University of Tennessee
  - Wuhan Polytechnic University
  - Frontiers of Structural and Civil Engineering
Tongji University
Chinese Society of Civil Engineering
International Association of Chinese Infrastructure Professionals
Chinese Academy of Engineering
TRB standing committees
- ADD40 Transportation and Sustainability
- AFB30 Low-Volume Roads
- AFD90 Surface Properties - Vehicle Interaction
- AFK20 Characteristics of Asphalt Materials
- AFK50 Characteristics of Asphalt Paving Mixtures to Meet Structural Requirements
- AFN10 Basic Research and Emerging Technologies Related to Concrete
- AFP50 Seasonal Climatic Effects on Transportation Infrastructure
- AFP60 Engineering Behavior of Unsaturated Soils
ASCE standing committees
- Bituminous Materials Committee
- Highway Pavements Committee

4. Impact

- What is the impact on the development of the principal discipline(s) of the program?
The first modules in the Environmental Life Cycle Assessment Learning Module Series are now available on the CESTiCC website. The modules are in PowerPoint format with narration and will automatically play the audio and advance slides when put in presentation mode. Each module is approximately twenty minutes long. They are intended to be used for professional development and training and as components in course curriculum to be used by students and professionals in the greater engineering community.

- Other Disciplines – Nothing to Report

- What is the impact on the development of transportation workforce development?
CESTiCC has provided numerous opportunities for the development and enhancement of the transportation workforce. Please see details in the how have the results been disseminated section on pages 5 - 7.

- What is the impact on physical, institutional, and information resources at the university or other partner institutions?
CESTiCC sponsored the UAF Concrete Canoe Team. Please see details in the what was accomplished under these goals section on page 2 – 4.
After the presentation by Quinn Langfitt (Dr. Liv Haselbach’s PhD student) to the group from the Indo-US Excellence Center for Design of Sustainable Products, Services and Manufacturing Systems, he has now been invited to attend a month long LCA workshop with the group in India in June 2015.

- What is the impact on technology transfer? – Nothing to Report

- What is the impact on society beyond science and technology?
Dr. Xianming Shi’s research on green winter maintenance technology has been picked up by journalists all over the nation. Please see details in the the research progress during this reporting period is summarized as follows section on pages 3-4.
5. Changes

- The UTC grant was modified in spring 2015 and a revised budget was submitted and approved by U.S. DOT OST-R.