Program Progress Performance Report for University Transportation Centers
SOLARIS INSTITUTE

Safety and Operations of Large-Area Rural/Urban Intermodal Systems Institute

Submitted to:
U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology (OST-R)

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EIN #: 88-6000024

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Reporting Period: April 1, 2017 to September 30, 2017
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Report Term: Semi-annual

Program Director:
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Reno, NV 89557

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1320-117-13SU

Signature of Submitting Official:

____________________________________
1. Accomplishments

1.1 What are the major goals and objectives of the program?
The major goals and objectives of the program as outlined in the proposal include the following categories.

Research
SOLARIS’s research is focused on safety in addition to other U.S. DOT strategic areas. The three main research areas involve: 1) Traffic Safety Data Management and Crash Mitigation; 2) Technologies for Safe Traffic Operations and Managements; and 3) Safe and Sustainable Infrastructure. SOLARIS will conduct applied research in all of these areas to produce methodologies and tools that can be implemented to tackle long-standing and emerging transportation issues. The expected outcomes of each research topic are listed below:

Traffic Safety Data Management and Crash Mitigation
- Improved quality of safety data through better data collection and inventory
- Implementation of scientifically sound crash data analysis methodologies and software tools
- Reduction of injury and fatal crashes in both rural and urban areas
- Maximization of the rate of return for all safety project investments

Technologies for Safe Traffic Operations and Management
- Congestion mitigation to reduce travelers’ frustration and to promote safe driving
- Reduction in air pollution and noise to promote livable communities
- Efficient freight movement to improve the regional and national economy

Sustainable and Safe Transportation Infrastructure
- Improved safety, mobility, and environment for tribal lands and rural towns
- Innovative materials that will prolong the life of pavements and bridges
• Expanding and integrating advanced traffic modeling technologies into infrastructure risk analysis under earthquake and other disastrous events

*Rigorous Project Selection Process*
To aid in the project selection process, SOLARIS organized a Technical Advisory Committee composed of professionals from public and private agencies. The Technical Advisory Committee is responsible for reviewing, ranking, and recommending research projects.

*Leadership*
SOLARIS is composed of several nationally and internationally known transportation programs and academic leaders. The resources from the five institutions composing the consortium make SOLARIS a highly qualified team that can significantly contribute to the advancement of transportation research. Four ways in which SOLARIS will measure the effectiveness of its leadership include studying innovative ideas that strengthen long-term vision and goals; delivering new models and tools that are readily implementable into practice, disseminating research through journal publications and conference presentations; participating in academic and professional organizations. The leadership group includes Center Director Zong Tian, Center Coordinator Erika Hutton, and Associate Directors Pitu Mirchandani from Arizona State University and Rafiqul Tarefder from the University of New Mexico.

*Education and Workforce Development*
Education and workforce development are important to the success of SOLARIS. The universities in the consortium currently have both undergraduate and graduate programs that focus on transportation. SOLARIS plans to enhance these transportation programs by providing course material in sustainability and mobility for large sparse rural-urban regions. Another educational and workforce development goal for SOLARIS is to hold workshops, conferences, and continuing education courses in order to educate the public, industry, and academic communities. Summer camps, internships, and fellowships will also be conducted in order to attract a new generation of professionals to transportation.

*Technology Transfer*
SOLARIS has established a plan in order to provide technology transfer. This plan includes the publication of reports, peer-reviewed journals, and conference papers; showcases; seminars; webinars; and international cooperation and collaboration. UNR hosts visiting scholars to present at seminars for transportation professionals and students. PhD and Master candidates are also
presenting at seminars every week at UNR. In addition, links to principal investigators presenting research through webinars is posted on the website.

**Collaboration**
SOLARIS has outlined the framework by which collaboration within the consortium, public agencies, educational and professional organizations, and industry and other private companies will be developed. This collaboration framework aims at providing collaborative brainstorming, research, decision making, and activities related to education and technology transfer. The following list provides detailed information about the different collaborative categories.

**Collaboration within the Consortium**
Some of the collaborative efforts involving the five institutions of SOLARIS include the sharing of transportation courses via interactive classrooms and distance learning technologies. This will provide students with a broad set of transportation-related courses, which no single university would be able to offer. SOLARIS has created collaborative committees in which faculty members from different institutions serve as graduate committee members. In addition, collaborative research between the institutions will best use institutional resources and expertise on delivering high quality research products.

**Collaboration with Public Agencies**
The different institutions composing SOLARIS have a strong collaborative effort with many transportation agencies. These agencies include the USDOT; the Departments of Transportation from Arizona, Nevada, and New Mexico; the Regional Transportation Commission (RTC) of Washoe County; the RTC of Southern Nevada; Maricopa County Department of Transportation, Maricopa Association of Governments, Cities of Phoenix, Tucson, and Tempe in Arizona; and the City of Las Vegas.

**Collaboration with Educational and Professional Organizations**
Outreach activities for K-12 schools and tribal colleges will focus on recruiting students that are interested in transportation research and education. The faculty members of the consortium are active in various professional organizations such as ASCE, ITE, TRB, APTA, INFORMS, and ITS America. In addition, the faculty members have or are currently serving as committee chairs in some of these organizations.
Collaboration with Industry and Private Companies
Partnerships with industry, industry-related organizations, and private companies are encouraged by SOLARIS in order to develop, promote and support transportation research and education. These types of collaboration efforts will effectively promote technology transfer activities.

1.2 What was accomplished under these goals?

Research
Quarterly progress reports are still being required to confirm projects are on schedule with a sufficient completion rate. The reports are now designed to fulfill the needs of matching organizations as well as the UTC program’s requirements.

Five additional projects from the second round have been completed and Final Reports have been submitted or will be submitted in the next month. They have also been published on the center’s website. The total number of completed projects is now 21.

Remaining projects are on schedule to be completed by end of grant.

Leadership
Center Coordinator Erika Hutton and Associate Directors Pitu Mirchandani (ASU) and Rafiul Tarefder (UNM) continue their roles at SOLARIS. Dr. Nader Ghafoori continues serving as the UNLV Coordinator.

Center Director Zong Tian is a member of the planning committees for two major international conferences: International Symposium on Enhancing Highway Performance (ISEHP 2016) and 2016 World Conference on Transportation Society (WCTRS). Dr. Tian continues his role as Technical Area Manager (TAM) for overseeing Area C of the WCTRS, which includes four Special Interest Groups covering traffic operations, traffic safety, highway capacity and design, and intelligent transportation systems.

Education and Workforce Development
The 2nd Civil/Transportation Engineering Summer Camp at UNR took place in July 2017. About 20 students registered for the weeklong camp, which consisted of lectures and activities in water treatment, pavement liquefaction, bridge building and traffic operations.
Technology Transfer
The center has been conducting weekly seminars. In these seminars, guest speakers and graduate students present their current research activities. Guest speakers are scheduled once a month, if possible, during the semester. The upcoming seminar schedule and past presentations are posted on the SOLARIS website.

Dr. Hao Xu presented the CATER Curvature tool at the AASHTO Standing Committee on Highway Traffic Safety (SCOHTS) and Safety Management 2017 Meeting in May. This tool is being used by the Departments of Transportation in Nevada, California, Connecticut, Nebraska, and Kansas as well as the University of Kentucky, the University of Connecticut and the consulting company Kimley-Horn, to prepare highway curve databases for traffic safety and other transportation applications.

Dr. Zong Tian conducted a signal-timing workshop on May 12 at the CalPoly campus in Southern California. A total of 14 engineers from state agencies, consulting firms, and academics participated in the workshop. Dr. Tian demonstrated the application of the TranSync tool, which has been adopted by Caltrans as their designated tool for timing development and performance evaluation.

INFORMS’ First Transportation Science and Logistics Conference was held July 26-29, 2017 in Chicago. ASU PI Pitu Mirchandani and graduate student Gita Ayu Ketut, in collaboration with SOLARIS and the conference organizing committee, developed and organized the conference. The conference included over 130 sessions on various transportation topics and two plenary talks. Conference attendees thought that the conference was a resounding success. Twenty scholarships of $300 were also given to PhD students who were giving presentations at the conference, which largely offset their registration fees for the conference.

Collaboration
The collaboration efforts SOLARIS has been part of during this reporting period include the following:

Collaboration within the Consortium
SOLARIS has successfully implemented a method in which faculty members from different institutions can serve as graduate committee members. This reporting period, Dr. Zong Tian from the University of Nevada, Reno served on a PhD Dissertation committee for Qiong Wu, originally at the University of New Mexico and now moved to University of Hawaii with Dr. Guohui Zhang.
Collaboration with Public Agencies

The Nevada Department of Transportation Board continues to match projects to be conducted by consortium members within Nevada, including the University of Nevada, Reno, the University of Nevada, Las Vegas, and the Desert Research Institute.

UNR researchers continue to work with the RTCs in both Washoe County and Las Vegas to address imminent transportation issues and improve transportation system efficiency, such as implementing new signal timing for arterial streets. Additionally, UNR researchers continue to collaborate with Caltrans in California for a project that involves design guidelines for metered on-ramps. UNR is assisting Carson City on a signal-timing project after the downtown roadway narrowing.

UNR and University of Arizona are collaborating on pursuing research projects to improve signal coordination for both Arizona and Nevada. Dr. Tian from UNR and Dr. Wu from UA are currently working on two projects, sponsored by the City of Tucson and Nevada DOT.

Dr. Tian is collaborating with RTC in Southern Nevada by providing a training on signal timing and a demo on one of the arterials to illustrate how TranSync can improve the efficiency of developing and implementing new timing plans.

The Nevada Highway Patrol provided feedback to the UNLV team working on the field test of a new mobile system for crash data collection.

Collaboration with Educational and Professional Organizations

UNR is collaborating with Beijing Institute of Technology, China to jointly develop a realistic signal system simulation system that would connect microsimulation, real NEMA controllers, physical small-size intersections and cars, which will be used for education and research purposes. This is the first-ever system that has been developed. It is anticipated to provide close-to-real signal control systems where students can learn the process of designing, implementing, and evaluating signal control in a lab environment. Two universities in China (Tianjin Chengjian University and Lanzhou Jiaotong University) have already made decisions on purchasing this system. During the summer, Dr. Tian provided a training and showcased the system at Tianjin Chengjian University in China. A system is being built and will be installed in UNR’s Traffic Signal Control Lab.
Collaboration with Industry and Private Companies

The Center for Advanced Transportation Education and Research (CATER) at UNR is still in the process of establishing an advanced traffic signal control lab with partial sponsorship from Econolite Inc. Econolite has donated their Centracs control software for research purposes and representatives from the company visited the lab on April 4. The lab construction concluded in June 2015. The ITS lab completion is currently in process. UNR has also been collaborating with Trans-Intelligence, LLC to advance the TranSync software. Trans-Intelligence provided $15,000 to support UNR’s effort.

Alon Asphalt USA, Ergon Asphalt Co. and Western Emulsions continue to supply engineered emulsions for the conduct of laboratory experiments and provide technical input on field applications and construction techniques. The research team has also been working with local agencies such as Carson City Public Works and Douglas County Public Works to collect materials from ongoing pavement construction projects.

Dr. Sanders of UNR collaborated with various companies to gain information on various sealers. These include Sika, Prosoco, Advanced Chemincal Tech, BASF, ChemMasters, Echem, Transportation Industries, Five Star and KwikBond.

Additional collaborations may be found in Table 2 under Section 3.2.

1.3 What opportunities for training and professional development has the program provided?

The weekly seminars are open to the general public, particular to local and state transportation agencies and graduate students. Webinars and training workshops are being planned to promote traffic signal timing and coordination practices.

1.4 How have the results been disseminated?

- Twenty-one total final reports have been completed and sent to the various agencies as required by the grant.
- Several presentations and publications have been made based on the research.

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

The following tasks are planned in order to accomplish the goals and objectives of SOLARIS.

- Stay updated on funded projects and their progress.
- Update SOLARIS website and RiP as necessary.
- Attend CUTC meeting in December.
- Continue fostering professional relationships for Distinguished Lecturer seminar series.

2. Products

2.1 Publications, conference papers, and presentations

Dr. Hao Xu was invited by the SHRP 2 Safety Data Oversight Committee to present research on driving cycle development with the SHRP 2 NDS data. The research focuses on using the data to analyze fuel economy and vehicle operating costs.

Dr. Hao Xu presented "Application of Roadside LiDAR Sensors for Connected-Vehicle Systems" at the 2017 Nevada Safety Summit.

Research from UNR funded through SOLARIS was cited in a USA Article Today highlighting self-driving car readiness in the US. PI Hao Xu's research titled "High-Resolution Micro-Traffic Data from Roadside LiDAR Sensors for Connected-Vehicles and New Traffic Applications" is leading the way with new technology to contribute to enhancements under a connected infrastructure.

Dr. Peter Sebaaly presented “Engineering Properties of Cold In-Place Recycling Mixtures” at UNR.

Dr. Pitu Mirchandani’s research assistant Kerem Demirtas presented “A Kalman Research Approach for Dynamic Calibration of a Simplified Lower-Order Car Following Model” and Dr. Mirchandani presented “From ‘No Data’ to ‘Some Data’ to ‘Big Data’ Towards a Cyber-Physical System for Proactive Traffic Management” at the TSL Conference in Chicago.
2.2 Website(s) or other internet site(s)
The SOLARIS website is located at http://www.unr.edu/solaris. This website is used to disseminate any information related to the program. It is updated monthly, or as needed.

2.3 Technologies or techniques
The TranSync tool will continue to be promoted to agencies to improve the current practice on signal timing and coordination. Field demos were provided to the following agencies: Portland, Denver, City of San Marcos, and City of Las Vegas.

Dr. Hao Xu at UNR has been testing the LiDAR technology on signal control and safety under the connected vehicle environment.

UNR is working with NDOT on implementing SafetyAnalyst software for traffic safety data management and analysis.

The pedestrian handling guide at coordinated signal systems has been used in signal timing projects in Reno and showed improved results due to minimization of signal transition.

UNR continues to develop a close-to-reality signal control system, which includes integration of TranSync, a virtual controller interface device (CID), and small-size physical intersections and cars. It is anticipated that this tool be used for class teaching and professional training purposes.

2.4 Inventions, patent applications, and/or licenses
Nothing to report for this period.

2.5 Other products
Nothing to report for this period.
3. Participants & Collaborating Organizations

3.1 Who has worked on the program?
The members of SOLARIS include the University of Nevada, Reno (UNR); the University of Nevada, Las Vegas (UNLV); Arizona State University (ASU); the University of New Mexico (UNM); and the Desert Research Institute (DRI). Table 1 lists the individuals who have worked on the program during this reporting period.

Table 1: SOLARIS Staff Working on the Program

<table>
<thead>
<tr>
<th>Name</th>
<th>Program/Project Role</th>
<th>Number of hours worked during the reporting period</th>
<th>Contribution to Program/Project</th>
</tr>
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<tbody>
<tr>
<td>Zong Tian</td>
<td>Program Director</td>
<td>180</td>
<td>Oversees overall operations of the program. Responsible for coordinating with stakeholders and developing and implementing the SOLARIS Strategic Plan.</td>
</tr>
<tr>
<td>Pitu B. Mirchandani</td>
<td>Associate Director at ASU</td>
<td>100</td>
<td>Serves as liaison between SOLARIS and ASU.</td>
</tr>
<tr>
<td>Rafiqul A. Tarefder</td>
<td>Associate Director at UNM</td>
<td>80</td>
<td>Serves as liaison between SOLARIS and UNM.</td>
</tr>
<tr>
<td>Nader Ghafoori</td>
<td>UNLV Coordinator</td>
<td>40</td>
<td>Serves as liaison between SOLARIS and UNLV.</td>
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<th>ASU</th>
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<td>Collaborated with individual in foreign country</td>
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<tr>
<td>Country(ies) of foreign collaborator</td>
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</table>
3.2 What organizations have been involved as partners?

Table 2 lists the organizations that have partnerships with SOLARIS and Table 3 lists the members of the Technical Advisory Committee.

Table 2: Organization Creating Partnerships with SOLARIS

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<thead>
<tr>
<th>Organization Name</th>
<th>Location of Organization</th>
<th>Financial Support</th>
<th>In-kind Support</th>
<th>Facilities</th>
<th>Collaborative Research</th>
<th>Personal Exchanges</th>
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<td>Econolite Control Products Inc.</td>
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<td>Ergon Asphalt Co</td>
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<td>Western Emulsions</td>
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<tr>
<td>Tracy Larkin (Chair)</td>
<td>Operations, Design</td>
<td>Deputy Director, NDOT</td>
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<tr>
<td>Mike Fuess</td>
<td>Traffic Operations</td>
<td>Assistant District Engineering, District 2, NDOT</td>
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<tr>
<td>Ken Mammen</td>
<td>Safety</td>
<td>Chief Safety Engineer, NDOT Planning</td>
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<tr>
<td>Steve Merrill</td>
<td>Design/GIS</td>
<td>Chief Engineer, Location Division, NDOT</td>
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<td>Troy Martin</td>
<td>Structure</td>
<td>Engineer, Bridge Division, NDOT</td>
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<tr>
<td>Nathan Morian</td>
<td>Pavement</td>
<td>Engineer, Materials Division, NDOT</td>
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<tr>
<td>Randy Travis</td>
<td>Traffic Information/Planning</td>
<td>Chief, Traffic Information, NDOT</td>
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<tr>
<td>Manju Kumar</td>
<td>Operations, Planning</td>
<td>Research Coordinator, NDOT</td>
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<td>Jim Poston</td>
<td>ITS/Operations</td>
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<td>Scott Gibson</td>
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<td>Engineer, RTC of Washoe County</td>
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<tr>
<td>Brian Hoeft</td>
<td>Traffic Operations</td>
<td>Director of FAST, RTC Southern Nevada</td>
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<tr>
<td>Raymond Hess</td>
<td>Transportation Planning</td>
<td>Manager, Planning Division, RTC Southern Nevada</td>
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<tr>
<td>Sondra Rosenberg</td>
<td>Transportation Planning</td>
<td>Assistant Director of Planning, NDOT</td>
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<td><strong>New Mexico</strong></td>
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<tr>
<td>Mohammad Moabed</td>
<td>Pavement/Traffic</td>
<td>Former District 2 Engineer, NMDOT</td>
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<tr>
<td>Parveez Anwar</td>
<td>Pavement Materials</td>
<td>Engineer, NMDOT</td>
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<tr>
<td>Sarath Joshua</td>
<td>ITS/Safety</td>
<td>Program Manager, Maricopa Association of Governments</td>
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<td>Scott E. Nodes</td>
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<tr>
<td>Robert Bertini</td>
<td>ITS/Traffic</td>
<td>Professor, Portland State University</td>
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**Academia (External)**
3.3 Have other collaborators or contacts been involved?
Caltrans has officially purchased and adopted TranSync tool for their signal timing projects.

4. Impact

4.1 What is the impact on the development of the principal discipline(s) of the program?
More awareness to Transportation Engineering within the college and community due to the various activities that have been created under the grant, including invited speakers, technology transfer and research.

4.2 What is the impact on other disciplines?
The grant has successfully supported a graduate student with a degree in Economics. He completed a research on addressing public transit accessibility.

4.3 What is the impact on the development of transportation workforce development?
Exchange of information has been made possible through Distinguished Lecturer Seminars, which include professional and academic entities, held at the University of Nevada, Reno.

4.4 What is the impact on physical, institutional, and information resources at the university or other partner institutions?
Our research in the signal control area has attracted interests from various agencies, which could become potential sponsors.

4.5 What is the impact on technology transfer?
Several presentations have been made at international and regional conferences. The signal timing tools have been tested in various agencies to improve the efficiency of developing signal timing plans. Our proposed signal timing methodology can have a major impact on the way we do signal coordination, for example, developing timing plans without traditional manual turning movement counts.
4.6 What is the impact on society beyond science and technology?
Improved signal system efficiency not only shows significant reduction in travel time and user costs, but also the improvement on air quality due to reduction in hazardous emissions. All these will bring improved quality of life for the citizens and protection of natural resources. Each of our signal timing projects has produced emission reductions up to 25 tons annually.

5. Changes/Problems

5.1 Changes in approach and reasons for change
Nothing to Report

5.2 Actual or anticipated problems or delays and actions or plans to resolve them
Nothing to Report

5.3 Changes that have a significant impact on expenditures
No significant impact is perceived.

5.4 Significant change in use or care of animals, human subjects, and/or biohazards
Nothing to Report

5.5 Changes of primary performance site location from that originally proposed
Nothing to Report

5.6 Additional information regarding products and impacts
Nothing to Report

6. Special Reporting Requirements
The University of Nevada, Reno’s Office of Sponsored Projects will submit Federal Financial Reports as needed.