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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____________________________________
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. So far, UNR has hosted 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 plans to create a method in which faculty members from different institutions can 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 projects from the first 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 first advisory board meeting was held in October at UNR to select new projects for funding. Twenty members attended, including PIs from the consortium to present progress on current projects. A total of 26 projects were reviewed and 15 were selected; three from UNM, three from ASU, two from UNLV, six from UNR and one from DRI.

**Leadership**

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

Center Director Zong Tian was appointed as an associate editor for the journal of Case Studies on Transport Policy. He is also a guest editor for a special issue for the Journal of Transportation Research – Part C. Additionally, he 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).

PI Dr. David Sanders of UNR was selected as a Fellow Member of the Structural Engineering Institute. He was formally recognized at a ceremony in Phoenix, AZ in February.
Education and Workforce Development
The Native American Scholarship has been opened year round and is posted on the SOLARIS website. Outreach to Pyramid Lake High School has been successful and communication to present the scholarship opportunity to students is currently underway.

Planning for the Civil/Transportation Engineering Summer Camp at UNR has commenced in collaboration between SOLARIS and the College of Engineering. The camp is set to take place in July and will consist of various civil engineering disciplines, including transportation activities and field trips.

Technology Transfer
The center has been conducting weekly seminars. In these seminars, guest speakers and graduate students present their current research activities. Distinguished Lecturers this period included: David Hale from Leidos, Inc. who made a presentation on October 22; Dr. Larry Rilett from the University of Nebraska, Lincoln presented on November 19. 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. Zong Tin presented at the Automated Signal Performance Measures Workshop held in Salt Lake City in January where more than 170 professionals from different DOTs, agencies ad private industries attended his presentation.

Various Demo Projects showcasing the signal timing software, TranSync, were completed and presented at several Caltrans workshops and ITE luncheon meetings. These demo projects showed benefit-cost ratios exceeding 150:1. The details are posted on the center’s website as well as on YouTube.

UNR conducted a survey on the policy of left-turn signal phasing. A total of 61 responses were received and a final report to summarize the results has been posted on SOLARIS website for agencies to share experiences across the nation.

Dr. Pitu Mirchandani was invited to give a plenary talk at the 5th Annual STOR-i workshop in January. Similar talks on “Routing, Logistics and Management of Recharging Infrastructure for Electric/Alternate-fueled Vehicles” were given at the University of California in February and at Amazon.com in Seattle in March.
Collaboration
The collaboration efforts SOLARIS has been part of during this reporting period include the following:

**Collaboration within the Consortium**
UNR and UNLV are still discussing the possibilities of offering web-based graduate level classes available for students at both universities. This would best use the available resources and faculty expertise in both institutions. 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 at the University of New Mexico. Dr. Pitu Mirchandani from ASU has previously served on a PhD committee at the University of Nevada, Reno.

Dr. Zong Tian visited the University of Arizona for collaboration efforts in the area of traffic signal control. He presented two seminars, one for students and one for local traffic engineers.

**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 have been collaborating with Caltrans in California, including a project that involves design guidelines for metered on-ramps. UNR will help Carson City on a signal-timing project after the downtown roadway narrowing. UNR is collaborating with University of Arizona on a project to evaluate signal communication alternatives. UNR is working with RTC, NDOT, and City of Reno on setting up a virtual traffic management center.

**Collaboration with Educational and Professional Organizations**
The center previously sponsored a graduate student interested in pursuing two advanced degrees, one in Economics and one in Transportation Engineering. Currently, graduate student Ben Claassen is being funded by the grant and plans to pursue two advanced degrees as well. The student will work on research funded jointly by the UTC and the Regional Transportation Commission of Washoe County (RTC) on public transit accessibility by using GIS analysis and possible regressions.
UNR is collaborating with Florida Atlantic University for evaluating adaptive signal control funded by Florida DOT. UNR supplied the virtual hardware-in-the-loop software which serves the key technology component of the project.

**Collaboration with Industry and Private Companies**

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

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.

1.4 How have the results been disseminated?

- Five Final Reports have been completed and sent to the various agencies as required by the grant.
- Several presentations were made at TRB and ITE meetings 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 annual meeting in June.
- Continue fostering professional relationships for Distinguished Lecturer seminar series.
- Host Civil Engineering Camp in partnership with the College of Engineering at UNR.
- Conduct at least one webinar on signal timing to draw a broad range of audiences.
2. Products

2.1 Publications, conference papers, and presentations
- UNR students won three out of six selected best student papers through a competition from the SHRP 2 sponsored safety research and presented their results during TRB in January.
- Dr. Zong Tian presented at the Automated Signal Performance Measures workshop held in Salt Lake City in January.
- Dr. Zong Tian made a presentation titled “new Way of Doing Signal Timing” at the Metropolitan Transportation Commission in the Bay Area in March.
- Survey of Policies on Left Turn Signal Phasing Sequence was completed and posted on the center’s website.
- Signal Timing Benefit-Cost Analysis Report was completed and posted on the website.
- Demo videos using TranSync have been posted on YouTube and the center website as well as shown in a number of presentations.

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.

The right-turn volume reduction guideline has been adopted by the Nevada Department of Transportation.

The study on vehicle acceleration and queue storage design at ramp meters has been approved by Caltrans, which will be used to update their Freeway Design Manual and Ramp Metering Design Manual.

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 is also developing the virtual controller interface device (CID), which will play a key role in conducting research in the signal control area.
2.4 Inventions, patent applications, and/or licenses
Dr. Pitu Mirchandani filed an Invention Disclosure Form on “A Proactive Traffic Signal Control System Based on Phase-time Network Model through an Open Computing Box Supplemental to Traffic Signal Controllers”.

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>
</thead>
<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>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Funding Support</th>
<th>UNR</th>
<th>ASU</th>
<th>UNM</th>
<th>UNLV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborated with individual in foreign country</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Country(ies) of foreign collaborator</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Traveled to foreign country (for center related business)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>If traveled to foreign country(ies), duration of stay</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### 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

<table>
<thead>
<tr>
<th>Organization Name</th>
<th>Location of Organization</th>
<th>Partners Contribution to Project</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Financial Support</td>
</tr>
<tr>
<td>Nevada Department of Transportation</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>Regional Transportation Commission of Washoe County</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>Regional Transportation Commission of Southern Nevada</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>Las Vegas Global Economic Alliance</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>New Mexico Department of Transportation</td>
<td>New Mexico</td>
<td></td>
</tr>
<tr>
<td>Maricopa Association of Governments</td>
<td>Arizona</td>
<td>X</td>
</tr>
<tr>
<td>Arizona Department of Transportation</td>
<td>Arizona</td>
<td></td>
</tr>
<tr>
<td>California Department of Transportation</td>
<td>California</td>
<td></td>
</tr>
<tr>
<td>Econolite Control Products Inc.</td>
<td>California</td>
<td></td>
</tr>
<tr>
<td>City of Carson City</td>
<td>Nevada</td>
<td></td>
</tr>
<tr>
<td>Douglas County</td>
<td>Nevada</td>
<td></td>
</tr>
<tr>
<td>Trans-Intelligence, LLC</td>
<td>Texas</td>
<td>X</td>
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</table>
# Table 3: Technical Advisory Committee Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Expertise</th>
<th>Position/Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nevada</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tracy Larkin (Chair)</td>
<td>Operations, Design</td>
<td>Deputy Director, NDOT</td>
</tr>
<tr>
<td>Mike Fuess</td>
<td>Traffic Operations</td>
<td>Assistant District Engineering, District 2, NDOT</td>
</tr>
<tr>
<td>Ken Mammen</td>
<td>Safety</td>
<td>Chief Safety Engineer, NDOT Planning</td>
</tr>
<tr>
<td>Steve Merrill</td>
<td>Design/GIS</td>
<td>Chief Engineer, Location Division, NDOT</td>
</tr>
<tr>
<td>Troy Martin</td>
<td>Structure</td>
<td>Engineer, Bridge Division, NDOT</td>
</tr>
<tr>
<td>Nathan Morian</td>
<td>Pavement</td>
<td>Engineer, Materials Division, NDOT</td>
</tr>
<tr>
<td>Randy Travis</td>
<td>Traffic Information/Planning</td>
<td>Chief, Traffic Information, NDOT</td>
</tr>
<tr>
<td>Manju Kumar</td>
<td>Operations, Planning</td>
<td>Research Coordinator, NDOT</td>
</tr>
<tr>
<td>Jim Poston</td>
<td>ITS/Operations</td>
<td>Engineer, RTC of Washoe County</td>
</tr>
<tr>
<td>Scott Gibson</td>
<td>Pavement</td>
<td>Engineer, RTC of Washoe County</td>
</tr>
<tr>
<td>Brian Hoeft</td>
<td>Traffic Operations</td>
<td>Director of FAST, RTC Southern Nevada</td>
</tr>
<tr>
<td>Raymond Hess</td>
<td>Transportation Planning</td>
<td>Manager, Planning Division, RTC Southern Nevada</td>
</tr>
<tr>
<td>Sondra Rosenberg</td>
<td>Transportation Planning</td>
<td>Assistant Director of Planning, NDOT</td>
</tr>
<tr>
<td><strong>New Mexico</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mohammad Moabed</td>
<td>Pavement/Traffic</td>
<td>Former District 2 Engineer, NMDOT</td>
</tr>
<tr>
<td>Parveez Anwar</td>
<td>Pavement Materials</td>
<td>Engineer, NMDOT</td>
</tr>
<tr>
<td><strong>Arizona</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sarath Joshua</td>
<td>ITS/Safety</td>
<td>Program Manager, Maricopa Association of Governments</td>
</tr>
<tr>
<td>Scott E. Nodes</td>
<td>Traffic/Design</td>
<td>Arizona DOT</td>
</tr>
<tr>
<td><strong>Academia (External)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robert Bertini</td>
<td>ITS/Traffic</td>
<td>Professor, Portland State University</td>
</tr>
</tbody>
</table>
3.3 Have other collaborators or contacts been involved?
City of Tucson is considering adopting TranSync for their regional signal timing.

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?
Currently, the grant is funding a graduate student with a degree in Economics. The student will work in collaboration with RTC to address 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?
After a new round of proposals, collaboration efforts between UNR and UNM have developed into research on autonomous vehicles.

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 project 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.