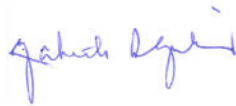


<b>Federal Agency</b>	U.S. Department of Transportation
<b>Federal Grant Number</b>	Grant No: DTRT12-G-UTC57
<b>Project Title</b>	METRANS UNIVERSITY TRANSPORTATION CENTER (UTC)
<b>Program Director Name, Title, Contact Information</b>	Genevieve Giuliano Director, METRANS Transportation Center Professor and Ferraro Chair in Effective Local Government Sol Price School of Public Policy University of Southern California (USC) RGL 216 Los Angeles, California 90089-0626 213-740-3956 213-740-0001 (fax) giuliano@price.usc.edu
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<b>DUNS/EIN Numbers</b>	072933393
<b>Recipient Organization (Name and Address)</b>	University of Southern California
<b>Recipient Identifying Number if any</b>	95-1642394
<b>Project/grant Period (start, end date)</b>	09/30/2013 – 09/30/2017
<b>Reporting Period End Date</b>	09/30/2016
<b>Report Term or Frequency</b>	PPPR for UTC. This report covers the period from April 1, 2016 to September 30, 2016, per Exhibit B, Grant Deliverables and Requirements for UTC Grants (June 2014)
<b>Signature of Submitting Official</b>	

# 1. Accomplishments

METRANS UTC is a partnership of the University of Southern California (USC) and California State University, Long Beach (CSULB). Its purpose is to conduct a multidisciplinary program of research, education, and technology transfer to increase the economic competitiveness of large metropolitan areas through improved transportation system performance across all surface transportation modes.

## 1.1 RESEARCH

The METRANS research program aims to generate knowledge that makes a significant contribution to solving urban transportation problems. Our approach is uniquely integrative: we address passengers and freight across all surface transportation modes. By designing policy incentives to implement effective strategies to address the needs of freight and passengers, system efficiency outcomes are achieved.

**1.1.1 Research Program Themes.** Theme 1 is Understanding Passenger-Freight Interactions, the basic forces underlying transport supply and demand, in three topic areas: relationships between spatial patterns and transportation, characteristics of freight and passenger demand, and better data for analysis of passenger-freight interactions. Theme 2 is Achieving System Efficiencies within and across modes and user classes and policy strategies that facilitate and promote these efficiencies. It includes two topic areas: integrated management across users and modes, and policies for more efficient urban transportation.

**1.1.2 Research Program Selection and Management.** Pre-selected Launch Projects are below.

Theme 1	Understanding Passenger-Freight Interactions	Funding
Topic 1-1	Spatial Patterns and Transportation	
1-1a	<i>Urban Spatial Structure, Employment Sub-Centers, and Passenger and Freight Travel</i>	Caltrans
1-1b	<i>Using Secondary Data Sources to Describe Metropolitan Freight Flows</i>	USDOT
Topic 1-3	Better Data for Analysis of Passenger-Freight Interactions	
1-3a	<i>Tracking Truck Flows with Programmable Mobile Devices</i>	Caltrans
Theme 2	Achieving System Efficiencies	Funding
Topic 2-1	Integrated Management Across Users and Modes	
2-1a	<i>Efficiencies in Freight and Passenger Routing and Scheduling to Reduce VMT</i>	USDOT
2-1b	<i>Design and Evaluation of Impact of Traffic Light Priority for Trucks on Traffic Flow</i>	USDOT
Topic 2-2	Policies for More Efficient Urban Transportation	
2-2	<i>Mitigating Urban Freight Through Effective Management of Truck Chassis</i>	Caltrans

### Year 1 Launch Project Progress Reports – All are Completed

**USC 1-1a: Urban Spatial Structure, Employment Sub-Centers, and Passenger and Freight Travel (Boarnet, USC).** This project examined freight traffic along road networks in LA to assess how the sub-centered employment patterns associate with freight flows and concluded employment is an important driver of freight activity, and employment subcenters have an independent effect on freight activity.

**USC 1-1b: Using Secondary Data Sources to Describe Metropolitan Freight Flows (Giuliano, USC).** We developed a method for describing spatial variation in freight supply and demand using population and employment data and found a significant relationship between development intensity and truck flows, supporting “freight landscape” as a proxy for freight flows.

**CSULB 1-3a: Tracking Truck Flows for Drayage Efficiency Analysis (Lam, CSULB).** Inefficient use of drayage trucks results in pollution and congestion. We tracked activities of terminals and obtained new data on turn times, speeds, repositioning time, and type of work. We also observed that counting on accurate and timely inputs by all drivers all the time is unrealistic; for tracking to be widely adopted logging of events must be automated.

**USC 2-1a: Efficiencies in Freight and Passenger Routing and Scheduling (Dessouky, USC).** We created, evaluated and scenario tested a solution approach to scheduling. This routing strategy showed merits for problems with a high level of uncertainty. Our proposed approach could generate routing solutions to reduce freight vehicle miles traveled, minimizing the impact of freight on passenger travel since they primarily share the same road network, especially in major urban centers.

**USC 2-1b: Design and Evaluation of Impact of Traffic Light Priority for Trucks on Traffic Flow (Ioannou, USC).** We developed two strategies for traffic light control in areas where the truck volume is relatively high. The results indicate that the average delay of all vehicles is reduced by 25% and the number of truck stops is reduced by 61% compared to the traffic light control approach that treats all vehicles the same. The strategy is currently under evaluation in an area near the ports of LA/Long Beach.

**CSULB 2-2: Mitigating Urban Freight through Effective Management of Truck Chassis (O'Brien, CSULB).** We assessed the potential benefits of shared chassis management as well as jurisdictional and institutional issues of coordinated equipment management procedures. We found most stakeholders see the shared equipment strategy as a temporary solution that will be replaced by a model in which the truck driver or trucking company manages and maintains the equipment as owner or under a long-term lease.

**Year 1 Open Solicitation Research Program.** RFP 1 was issued in spring 2014. We received 15 valid proposals; 5 were funded. Projects started Jan. 2015. Remaining funds were retained for Year 2 research.

Theme 1	Understanding Passenger-Freight Interactions	Funding
Topic 1-3	Better Data for Analysis of Passenger-Freight Interactions	
14-06	<i>Development of Micro Wireless Sensor Platforms for Collecting Data of Passenger-Freight Interactions.</i>	Caltrans
14-13	<i>Smart Truck Driver Assistant: A Cost Effective Solution for Real Time Management of Container Delivery to Trucks</i>	Caltrans
Theme 2	Achieving System Efficiencies	Funding
Topic 2-1	Integrated Management Across Users and Modes	
14-09	<i>A Dynamical Framework for Integrated Corridor Management</i>	Caltrans
14-11	<i>Vehicle-to-Vehicle Communications in Mixed Passenger – Freight Convoys</i>	Caltrans
Topic 2-2	Policies for More Efficient Urban Transportation	
14-04	<i>Analysis and Prediction of Spatiotemporal Impact of Traffic Incidents for Better Mobility and Safety in Transport. Systems</i>	Caltrans

**Year 1 Open Solicitation Project Progress Reports – All are Completed**

**CSULB 14-06: Development of Micro Wireless Sensor Platforms for Collecting Data of Passenger-Freight Interactions (Mozumdar, CSULB).** We developed an in-node microprocessor-based approach to analyze and determine the types of vehicles passing over a 3-axis magnetometer sensor. The results show that the vehicle classification system is effective and efficient with accuracy above 98%.

**CSULB 14-13: Smart Truck Driver Assistant: A Cost Effective Solution for Real Time Management of Container Delivery to Trucks (Englert, CSULB).** We tracked movements, measured turn times, developed a prototype and completed testing. On the client side, it allows drivers to get data on container pick-ups and drop-offs. On the server side, terminals and trucking companies can monitor and track truck movements and turn-times in real time.

**USC 14-09: A Dynamical Framework for Integrated Corridor Management (Savla, USC).** We extended our case studies on the downtown LA subnetwork to include a resilience comparison between proportionally fair and max pressure algorithms, formulated the freeway network control (FNC) problem, and clarified its relationship to the system optimum dynamic traffic assignment problem. We also developed robustness bounds, orders of magnitude tighter than those obtained through standard sensitivity analysis and matched the perturbation bounds obtained from simulations, for a benchmark network.

**USC 14-11: Vehicle-to-Vehicle Communications in Mixed Passenger – Freight Convoys (Molisch, USC).** We investigate characteristics of radio propagation channels in scenarios where both trucks and passenger cars are on the road, between cars and trucks or between cars whose connection is blocked by trucks. Performance for the measured channels was estimated and compared with the literature.

**USC 14-04: Analysis and Prediction of Spatiotemporal Impact of Traffic Incidents for Better Mobility and Safety in Transportation Systems (Shahabi, USC).** We studied global learning and incremental learning methods for time-dependent latent attributes and implemented an algorithm to learn the latent attribute from the temporal graph changes. Our techniques accurately predict traffic speed with 10% deviation with the ground-truth value, improving existing time series prediction techniques by 25%.

**Year 2 Open Solicitation Research Program.** RFP 2 was issued Dec. 2014. Fifteen complete proposals were received and ten were funded. See Table 3 below.

<b>Table 3: Year 2 Open Solicitation Projects, RFP 2</b>			
<b>Theme 1</b>	<b>Understanding Passenger-Freight Interactions</b>	<b>Status</b>	<b>Funding</b>
Topic 1-2	Characteristics of Freight and Passenger Demand		
15-01	<i>Investigations of the Effect of Humid Air on NOX &amp; PM Emissions of a CNG Engine</i>	Completed	Caltrans
15-02	<i>Simulation of liquefaction-induced damage of the Port of Long Beach using the UBC3D-PLM model</i>	Completed	Caltrans
15-10	<i>Route Choice Characteristics of Owner-Operated Trucks in Southern California Freeways</i>	Completed	Caltrans
15-15	<i>The Decline in Inter- and Intra-Urban Mobility and its Impact on Passenger Travel</i>	Active	Caltrans
<b>Theme 2</b>	<b>Achieving System Efficiencies</b>	<b>Status</b>	<b>Funding</b>
Topic 2-1	Integrated Management across Users and Modes		
15-03	<i>Development of an Economic Framework to Evaluate Resilience in Recovering from Major Port Disruptions</i>	Completed	Caltrans
15-04	<i>Integration of Passenger and Freight Rail Scheduling</i>	Completed	Caltrans
15-08	<i>Application of a Regional Multi-Modal Transportation System Performance Monitoring Framework</i>	Active	DOT
15-12	<i>Optimum Routing of Freight in Urban Environments under Normal Operations and Disruptions using a Co-simulation Optimization Control Approach</i>	Active	DOT
15-14	<i>Quantifying the Impact of Next-Generation Modes of Delivery</i>	Completed	DOT
Topics 2-1 and 2-2	Integrated Management across Users and Modes and Policies for More Efficient Urban Transportation		
15-13	<i>Developing Affordable Housing Guidelines Near Rail Transit in Los Angeles</i>	Active	Caltrans
15-01	<i>Investigations of the Effect of Humid Air on NOX &amp; PM Emissions of a CNG Engine</i>	Completed	Caltrans
15-02	<i>Simulation of liquefaction-induced damage of the Port of Long Beach using the UBC3D-PLM model</i>	Completed	Caltrans
15-03	<i>Development of an Economic Framework to Evaluate Resilience in Recovering from Major Port Disruptions</i>	Completed	Caltrans

Because few proposals addressed Caltrans topics, another Year 2 RFP was issued in March, 2015 and included a solicitation for NCST Year 2 projects. Proposals were due in April, 2015. Nine were received and seven were funded, one using Tier 1 funding (see Table 4 below). Start date was January 1, 2016.

Table 4: Year 2 Open Solicitation Projects, RFP No. 3		Status	Funding
Theme 1	Understanding Passenger-Freight Interactions		
Topic 1-1	Relationships Between Spatial Patterns and Transportation		
15-27	<i>Spatial Dynamics of Warehousing and Distribution in California</i>	Active	Caltrans

#### Year 2 Open Solicitation Project Progress Reports, RFPs 2 and 3

**CSULB 15-01: Investigations of the Effect of Humid Air on NOx & PM Emissions of a CNG Engine (Rahai, CSULB) (8/15/2015 – 8/14/2016). This project is completed.** Numerical and experimental investigations of the effect of a humid air system on nitrogen oxides (NOx) and Particulate Matter (PM) emissions of a compressed natural gas (CNG) engine were performed. Numerical results have shown 40% reduction in NO emission at 10% relative humidity, when compared with emissions of dry intake air. With 15% and 30% relative humidity levels, NO emissions were reduced by 65% and 93% respectively. For experimental investigations, a General Motors inline 4 cylinders, naturally aspirated engine with a maximum rated horsepower (HP) of 50.8 for natural gas fuel was used. The engine was connected to a water-cycled dynamometer. Results show for each additional 15% increase in relative humidity, there was a nearly 10% reduction in NOx emission, which is nearly consistent with the corresponding drop rate between 15% and 30% relative humidity from the numerical simulations. These results indicate that humid air system is an effective approach for reducing NOx emission of CNG engines without significant increase in PM emission which could make CNG engines near net zero.

**CSULB 15-02: Simulation of Liquefaction-Induced Damage of the Port of Long Beach Using the UBC3D-PLM Model (Arboleda-Monsalve, CSULB) (8/15/2015 – 8/14/2016). This project is completed.** Southern California has an extensive record of seismic events. The Port of Long Beach is located within a few miles of the San Andreas Fault, and is near the Newport-Inglewood and the Palos Verdes faults. Port facilities have been expanded by placing hydraulic fills behind rock retention dikes. These loose man-made fills and even their subjacent deposits are susceptible to liquefaction. We analyzed the subsurface exploration of the port, completed numerical modeling, and evaluated liquefaction susceptibility, and drew conclusions regarding the onset of liquefaction and the resulting settlements after the dissipation of excess pore water pressures in the post-earthquake stages. Conclusions, observations, and recommendations were issued to understand the role of numerical modeling in engineering on the resiliency of the Port of Long Beach, which is vital for the California freight network.

**USC 15-03: Developing an Economic Framework to Evaluate Resilience in Recovering from Major Port Disruptions (Wei, USC) (8/15/2015 – 8/14/2016). This project is completed.** We developed an operational and analytical framework to evaluate the effectiveness of a comprehensive list of relevant resilience options that can help ports and related businesses in the supply chain recover more rapidly from port disruptions. The modeling results indicate that the lower-bound scenario could result in a GDP loss of \$650.1 million and an employment loss of 7,000 jobs. The combined effects of various relevant resilience tactics have the potential to reduce the economic losses by about 97%. The upper-bound scenario could cause total GDP losses of over \$12 billion in California and \$16 billion at the national level. However, resilience can reduce these impacts by about 75% for California and about 89% for the nation as a whole. Major resilience tactics on the supplier-side are ship re-routing and export diversion for import use. Major resilience tactics on the customer-side are use of inventories and production recapture. The port resilience analytical framework developed in this study is readily generalizable to port disruptions from other causes and at other geographical scales.

**USC 15-04: Integration of Passenger and Freight Rail Scheduling (Dessouky, USC) (8/15/2015 – 8/14/2016). This project is completed.** This project developed a methodology to integrate passenger and freight rail scheduling when they share the same tracks to reduce train delay on major corridors. Typically, scheduling for passenger and freight trains is performed separately. Passenger train schedules are usually based on fixed timetables, whereas with freight scheduling there is more flexibility in setting

departure times. We investigated the impact and potential benefits of integrating the scheduling of these two types of trains. We used the rail network from Downtown Los Angeles to Colton as our test case. We showed that by integrating passenger and freight train scheduling, passenger train punctuality is improved and freight train travel delays are reduced. A draft final report was submitted in September 2016.

**USC 15-08: Application of a Regional Multi-Modal Transportation System Performance Monitoring Framework (Giuliano, USC) (8/15/2015 – 9/30/2017 (no cost extension)).** This research examines the characteristics and explanatory factors associated with intra-metropolitan variation in highway and arterial system performance. Better understanding of performance variation supports more effective transportation system management. We first investigate whether significant performance (speed, flow, and buffer index) variation exists across functionally comparable roadway sections, various times of day, days of week, and time periods of the year. Then, we perform statistical tests to analyze and identify location and network factors that determine systematic or idiosyncratic variations. Finally, we consider how our results could be used to improve system performance across modes, locations, and times.

**CSULB 15-10: Route Choice Characteristics of Owner-Operated Trucks in Southern California Freeways (Kim, CSULB) (8/15/2015 – 8/14/2016). This project is completed.** We developed a full research design to evaluate route choice characteristics used by owner-operated truck drivers when choosing from different types of roads. The problem of truck routing and the choices associated with it is a major focus of concern in transportation agencies. We have analyzed the key factors that truck drivers consider when deciding which route to take through the literature on the subject matter. Based on the factors, an analytic hierarchy process (AHP) survey was designed to obtain the significance level of each of these for the informed decision making process of which route to take. When developing the full research design based on the factor analysis results, we explored the number of alternatives and specific examples such as Interstates 110 and 710 during the peak gate hours. Route choice attributes we considered in the scenarios include cost measure, reliability measure, travel time measure, safety measure, weather measure, time of day measure, scheduled delivery time measure, truck cargo price measure, truck gas mileage measure, and truck comfort measure. The full research design is well prepared to be used in the field for collection of stated preference data. The findings can be used to build off a further research that is necessary for comprehensive benefit-cost analysis concerning toll roads or truck only lanes.

**USC 15-12: Optimum Routing of Freight in Urban Environments under Normal Operations and Disruptions using a Co-Simulation Optimization Control (Ioannou, USC) (8/15/2015 – 8/14/2016). This project is completed.** The complexity and dynamics of multimodal freight transportation together with the unpredictability of incidents, disruptions and demand changes make the optimum routing of freight a challenging task. The purpose of this project was to use complex real time simulation models to estimate the states of the transportation network and integrate that knowledge with optimization and load balancing techniques in an iterative feedback configuration that would lead to much more efficient routing decisions during normal operations and disruptions. The approach is referred to as the CO-Simulation Optimization (COSMO) approach. In this project we formulated the problem and develop the various blocks of approach. We use a simulation testbed consisting of a road traffic simulation model and a rail simulation model for the Los Angeles/Long Beach Port area to demonstrate the efficiency of the proposed approach. The results demonstrate the potential of the approach for practical freight routing. They also raise many more research and practical problems that need be addressed in subsequent projects.

**USC 15-13 Development of Affordable Housing Guidelines near Rail Transit in Los Angeles (Bostic, USC) (8/15/2015 – 12/31/2016 (no cost extension)).** We continue to make revisions to the models that generate our estimates of changes in vehicle miles travelled and affordable housing units produced. These revisions were based on continued feedback received from seminar and conference presentations about this project. The changes were sufficiently significant that we revisited our submitted journal article and resubmitted it to the *Journal of the American Planning Association* in August, 2016.

**USC 15-14: Quantifying the Impact of Next-Generation Modes of Delivery (Carlsson, USC) (8/15/2015 – 8/14/2016). This project is completed.** The purpose of this project is to apply quantitative tools from geospatial analysis, geometric probability theory, and mathematical optimization to predict the impacts that new delivery paradigms will have on traffic congestion and carbon emissions. There is an unprecedented expansion of last-mile delivery services that transport products to households within a short time frame. The net impact is that a person's trip to the store is now replaced by a trip taken by a third party, which might benefit from an economy of scale by, for example, taking an efficient route through multiple households at once, aggregating demand more efficiently. We model this change within a mathematical optimization framework to determine the circumstances under which these services can provide the greatest social benefit. We have completed and reported the findings of our project, namely a literature review, an analysis of multi-stop trips, and a study of temporally-varying demand and the impacts of profit maximization. We have found that delivery services can potentially reduce the carbon emissions in a region, although we currently estimate that the overall rate of adoption must be quite high - roughly 15 percent -- in order for these benefits to be realized.

**USC 15-15: The Decline in Inter- and Intra-Urban Mobility and its Impact on Passenger Travel (Painter, USC) (8/15/2015 – 12/31/2016 (no cost extension)).** This project consists of three parts: 1) analyze characteristics and implications of declining US migration trends, 2) conduct empirical analyses to determine how current trend affects urban passenger travel demand, and 3) discuss strategies to help achieve national/regional transportation policy goals considering current population dynamics. We have developed the methodology, reviewed the literature, and considered data availability and accuracy. We performed geospatial data collection and preparation, and addressed a major geospatial incongruency problem in this study period. We have started conducting a longitudinal analysis of the determinants of transit ridership across US urbanized areas, isolating how inter-urban migration affects ridership by altering demographic landscapes. The estimated effect is expected to help forecast the demand for transit use across select cities that are most affected by the decline in mobility. Finally, we explore and discuss various supply and demand side strategies aimed at managing auto demand and encouraging transit use.

**USC 15-27: Spatial Dynamics of Warehousing and Distribution in California (Giuliano, USC) (12/1/2016 – 12/31/2016).** The purpose of this research is to document and analyze the location patterns of warehousing and distribution activity in California. Population and economic growth, shifting supply chains and distribution practices, scale economies in warehousing, and California's role in international trade are affecting the growth and spatial patterns of warehousing and distribution (WD) activities. The location of WD activities has implications for freight demand and flows, and thus is a critical element in statewide transportation planning. We finished Task 1 and 2 and have worked on Task 3. We have collected literature on logistics spatial trends and drafted a summary chapter. We have assembled and verified state wide transportation infrastructure and ZBP datasets, which provide WD location and activity attributes. Simultaneously, we have described changes in numbers and spatial patterns of WDs with respect to the distribution of employment, population, and transportation infrastructure. We are in the process of generating multiple maps that present WD facilities and transportation infrastructure, such as highway systems, major airports, seaports, and intermodal facilities throughout California. We have developed a detailed methodology of statistical analysis of WD trends (Task 4).

We issued our Year 3 RFP (<http://www.metrotrans.org/research-projects/metrotrans-utc>) on March 11, 2016, with proposals due April 15, 2016. We issued this RFP to allocate remaining research funding from the METRANS Tier 1 funds and the NCST funds, including remaining funds from previous years. We received 17 complete proposals and selected 7 for Tier 1 funding. See Table 5. Projects will begin January 1, 2017, and will end December 31, 2017.

<b>Table 5: Year 3 Open Solicitation Projects (RFP 4)</b>		
<b>Theme 1</b>	<b>Understanding Passenger-Freight Interactions</b>	<b>Funding</b>
Topic 1-2	Characteristics of Freight and Passenger Demand	
16-13	<i>Fine grained “automatic vehicle classification” system development for accurately measuring passenger-freight interactions</i>	Caltrans
<b>Theme 2</b>	<b>Achieving System Efficiencies</b>	<b>Funding</b>
Topic 2-1	Integrated Management across Users and Modes	
16-02	<i>A Cost Allocation Model for Horizontal Supply Chains</i>	Caltrans
16-07	<i>Sustainable and Affordable Housing Near Rail Transit: Refining and Expanding a Scenario Planning Toll</i>	Caltrans
Topic 2-2	Policies for More Efficient Urban Transportation	
16-08	<i>Innovating on Job Accessibility with General Transit Feed Specification Data</i>	DOT
16-06	<i>Trajectory Data Mining for Performance Measurement of Public Transportation Systems</i>	Caltrans
Topic 2-1	Integrated Management Across Users and Modes	
16-05	<i>Evaluating Economic Mobility and Resilience of Multimodal Freight Operations in a Connected Vehicle Environment</i>	Caltrans
16-16	<i>A Computational Framework for Data-Driven Distributed Resilient Control of Traffic Corridors</i>	DOT

### Year 3 Open Solicitation Project Progress Reports

**USC 16-02 A Cost Allocation Model for Horizontal Supply Chains (Carlsson, USC).** This project addresses the cost allocation problem in a real-time cost sharing transportation system, which results from horizontal cooperation among multiple suppliers. The research will develop an online cost-sharing mechanism by adapting existing research for use in a dynamic environment. The mechanism works alongside a look-ahead vehicle routing framework, which has been developed in a previous project to efficiently solve the dynamic vehicle routing problem with different levels of uncertainty. In this problem, new customers become known in real time and the optimal total cost of service can only be approximated. Whereas traditional cost-sharing mechanisms are designed to solve static cost-sharing problems -- that is, where the set of players and the exact costs of serving any subset of the players are known -- in the dynamic vehicle routing problem, the set of players is not known as new customers may request service any time, and thus the optimal cost cannot be calculated. The resulting model will show how horizontal cooperation could reduce the total cost of transportation systems, and potentially lower the cost barrier for new businesses to enter the market.

**CSULB 16-05: Evaluating Economic Mobility and Resilience of Multimodal Freight Operations in a Connected Vehicle Environment (Chandra, CSULB).** This research evaluates the role of connected vehicle technology (CVT) in mobility and resilience building of multimodal freight operations, useful for freight planning purposes at the time when freight manufacturing companies are competing to roll out their next generation fleet of vehicles fully loaded with CVT features. This urgency in technological advancements for freight is in anticipation that soon vehicles constituting the multimodal system will be required to “talk to each other.” We first understand the complexities associated with constituents/factors that impact mobility and resilience of multimodal freight operations – independent of CVT. We evaluate the influence of CVT reliability on routing of freight vehicles for mobility and resilience in the multimodal operation. A probabilistic model is being developed for reliability of the communication network which will relate to travel time changes for mobility as well as for resilience during any network disruptions (also termed as CVT-induced route finding for multimodal operations in this research). Economic costs of CVT-induced routes are determined for commercial trucks, freight rail, seaports and



airport at the spatial resolution of Traffic Analysis Zone. We conclude with examples of multimodal routes which may or may not benefit with CVT significantly due to poor transportation infrastructure.

**USC 16-06: Trajectory Data Mining for Performance Measurement of Public Transportation Systems (Demiryurek, USC).** The main objective of this research is to develop a system that can process massive amounts of GPS trajectories from public transportation vehicles and implement statistical algorithms to analyze variety of public transportation system performance metrics such as travel-time reliability, on-time performance, bus bunching and travel-time estimation. To this end, we will conduct fundamental research in mining and correlation of real-time and historical bus GPS trajectory datasets in LA County, which we have collected and archived in our database over the past four years. This research will exploit the real-world Los Angeles traffic sensor and bus GPS datasets collected from Regional Integration of Intelligent Transportation Systems (RIITS) under Archived Traffic Data Management System (ADMS) project. Such analysis of trajectories from our research can help to increase the efficiency of the public transportation systems. The output from our research can be used by city transportation agencies to identify the problem with bus lines, quantify the delays caused by various reasons. Even long-term policy decisions can be made to rearrange bus timetables. Our research can also benefit riders to have a better understanding and access to travel-time delays and reliability.

**USC 16-07: Sustainable and Affordable Housing Near Rail Transit: Refining and Expanding a Scenario Planning Tool (Bostic, USC).** In previous research, we showed that promoting transit-oriented development (TOD) to achieve greenhouse gas (GHG) emission reduction in Los Angeles could be at odds with providing access to affordable housing near transit, because higher income households tend to reduce driving the most when living near transit. This project builds on that research to broaden it by assessing how changes in emission reduction technology relate to household vehicle miles travelled (VMT), expanding the generalizability of the previous study beyond Los Angeles, and addressing residential self-selection and its impact on household VMT. As before, we will create development scenarios, but this time will work to add the San Diego and Sacramento geographies to Los Angeles. We will enhance the precision of our planning tool estimates of the GHG implications of different development typologies by coupling information on the types of autos used by people of different income levels with emissions models. These data allow us to estimate actual changes in emissions.

**USC 16-08: Innovating on Job Accessibility with General Transit Feed Specification (GTFS) Data (Painter, USC).** Physical access to economic opportunity is still a factor dominated by geography. Job growth often happens in places away from the populations that need the new jobs: also known as spatial mismatch. Currently, cars are the primary barrier to entry in bridging that gap for job seekers in metropolitan areas. Cars provided access to an order of magnitude larger number of jobs than transit access. We argue that public transportation could and should play a role in providing access to jobs. In this research, we use a new open data tool, General Transit Feed Specification data, to dynamically analyze travel times that exist within public transit networks. We are then able to link these data to job sub-centers across the LA metropolitan area using Census tract data to determine the accessibility of jobs to high poverty neighborhoods. We can further distinguish job clusters by industry type to highlight if there are differences in accessibility between emerging economy jobs in the information technology (IT) sector and the general job market. Finally, we can create transit access measures that can be widely used and rapidly deployed in a broad range of contexts. We plan to make these measures available in an online environment (i.e. web maps) as a proof-of-concept based on the Los Angeles area.

**CSULB 16-13 Fine Grained “Automatic Vehicle Classification” System Development for Accurately Measuring Passenger-Freight Interactions (Mozumdar, CSULB).** We target the design of vehicular road sensing networks used in the framework for Intelligent Transportation Systems. We will develop machine-learning models, optimized power-saving algorithms, communications protocols, and a low-power sensing platform to yield a novel and modular multi-node system for “automatic vehicular detection and classification” (motorcycles, passenger cars, buses, trucks, etc.). We propose to create smart

highways by implanting wireless Micro-Electro-Mechanical System sensors, which will act like neurons to collect traffic data for vehicular movement. The proposed smart sensing and data interpretation system for smart roadways will be scalable, cost-effective, maintain a small foot-print, and capable of detecting and classifying a vehicle in real-time. We will focus on all levels of system design from architecture to computation to communication design.

**USC 16-16 A Computational Framework for Data-Driven Distributed Resilient Control of Traffic Corridors (Savla, USC).** In this project, we develop algorithms for distributed control and model parameter estimation for traffic flow over freeway and arterial networks, with provable guarantees. The research will lead to rigorous tools for online calibration of key traffic model parameters such as turn ratios and origin-destination matrices from traffic sensors, and scalable computational tools for real-time traffic management of integrated freeway-arterial networks. Our approach relies on a combination of tools from traffic engineering, control theory, optimization, dynamical systems, and signal processing. Our analysis and algorithm development is supplemented with case studies relevant to the LA area, especially with regards to traffic management under incidents, using a microscopic traffic simulator.

**1.1.3 Dissemination.** Research reports are published to the METRANS website and presented at METRANS research seminars, open to the public. Preliminary results are often presented at conferences. All projects are expected to result in refereed publications.

*The following papers are under review or under preparation for a journal submission:*

Bostic, R., Boarnet, M., Rodnyansky, S., & Santiago-Bartolomei, R. *Environmentally Sustainable and Affordable Housing Near Transit in Los Angeles.*

Carlsson, J. *Bounds for the Euclidean generalized TSP* submitted to *Operations Research*.

Carlsson, J., Meng, X., Behroozi, M., & Devulapalli, R. *Household-Level Economies of Scale in Transportation*

Dessouky, M., & Zou, H. *A Look-Ahead Routing Strategy for Solving the Dynamic Vehicle Routing Problem.*

Englert, B. (n.d.). *A Smartphone-Based Truck Monitoring System for the Ports of LA and Long Beach.*

Englert, B., Aliasgari, M., & Asgari, S. *Smart Truck Driver Assistant: A Cost Effective Solution for Real Time Management of Container Delivery to Trucks.*

Giuliano, G., S. Kang, Q Yuan, *Using proxies to describe the metropolitan freight landscape* (revised and resubmitted to *Urban Studies*)

Lam, S. *Tracking Truck Flows for Drayage Efficiency Analysis.*

Liu, L., & Dessouky, M. (n.d.). *A Decomposition Based Hybrid Heuristic Algorithm for Integrated Passenger and Freight Train Scheduling* submitted to *Computers & Operations Research*.

Savla, K. *Distributed Algorithms for the Dynamic Network Traffic Assignment.*

Savla, K. *Throughput Optimality of Proportionally Fair Traffic Signal Control Policies under General Phase Architectures.*

Wei, D., Chen, Z., & Rose, A. *Evaluating the Role of Resilience in Recovering from Major Port Disruptions.*

Zhang, Y., & Ioannou, P. *Combined Variable Speed Limit and Lane Change Control for Highway Traffic.*

Zhao, Y., Ioannou, P., & Dessouky, M. *Routing of Multimodal Freight Transportation Using a Co-Simulation Optimization Approach.*

Zhao, Y., Vital, F., & Ioannou, P. *Traffic Light Priority System for Trucks and Impact on Traffic Flows.*

*The following were published:*

Ioannou, P., & Zhang, Y. (2016, July 4-6). *Intelligent Driver Assist System for Urban Driving.* IEEE Digital Media Industry & Academic Forum (DMI AF) 2016, Santorini, Greece. 128-134.

Zhang, Y., & Ioannou, P. (2016 May 18-20). *Environmental Impact of Combined Variable Speed Limit and Lane Change Control: A Comparison of MOVES and CMEM Model.* 14th IFAC Symposium on Control in Transportation Systems 2016, Istanbul, Turkey. 49, 323-328.

Zhao, Y., & Ioannou, P. (2016 May 18-20). *A Traffic Light Signal Control System with Truck Priority*. 14th IFAC Symposium on Control in Transportation Systems 2016, Istanbul, Turkey. 377-382.

*The following were recently submitted for conference presentation:*

Arboleda-Monsalve, L., Mercado, J., Sover, A., & Zapata-Medina, D. (2017, March 12-15). *Liquefaction of a Major U.S. Port Facility using the UBC3D-PLM Constitutive Soil Model*. GeoFrontiers 2017, Orlando, FL.

Bostic, R., Boarnet, M., Rodnyansky, S., & Santiago-Bartolomei, R. (2016, October). *Environmentally Sustainable and Affordable Housing Near Transit in Los Angeles*. North American Regional Science Conference, Minneapolis, MN.

Giuliano, G. (2016, November 3-6). *Application of the Los Angeles Archived Data Management System (ADMS) to analyze intra-metropolitan variation in highway and arterial system performance*. 56th Annual Conference of the Association of Collegiate Schools of Planning.

Mercado, J., Arboleda-Monsalve, L., Zapata-Medina, D., & Star, L. (2017, June 4-6). *Probabilistic Evaluation of Earthquake-Induced Settlements of the Port of Long Beach using Classical Approaches*. GeoRisk 2017: Geotech. Risk from Theory to Practice in Geo-Institute-ASCE, Denver.

Painter, G., & Chakrabarti, S. (2016, November 3-6). *How Does Population Migration Affect Travel Demand? An Analysis of Transit Ridership across U.S. Metropolitan Areas Over 2006-2013*. 56th Annual Conference of the Association of Collegiate Schools of Planning.

Preciado, D., & Arboleda-Monsalve, L. (2016, October 13-15). *Probabilistic Evaluation of Earthquake-Induced Settlements in the Port of Long Beach*. Conference SACNAS, the National Diversity in STEM Conference in Convention Center, Long Beach.

*During this reporting period, the following were presented:*

Deng, D., Shahabi, C., Demiryurek, U., Zhu, L., Yu, R., & Liu, Y. (2016, August). *Latent Space Model for Road Networks to Predict Time-Varying Traffic*. International Conference on Knowledge Discovery and Data Mining (KDD 2016), San Francisco.

Ioannou, P., & Zhang, Y. (2016, July 4-6). *Intelligent driver assist system for urban driving*. IEEE Digital Media Industry & Academic Forum (DMI AF), Santorini, Greece.

O'Brien, T. (2016, July). *Trucking Regulation as a Critical Supply Chain Asset in Port Complexes*. 14th Conference on World Congress on Transport Research in Shanghai.

Preciado, D., Avila, N., & Arboleda-Monsalve, L. (2016, July/August). *Simulation of Liquefaction-induced damage of the Port of Long Beach using the UBC3D-PLM model*. California State University Program, HSI-STEM Summer Bridge at the Beach, Long Beach, CA.

Wei, D. (2016, March/April). *Economic Resilience in Recovering from Major Port Disruptions*. Annual Conference of American Association of Geographers, San Francisco, California.

Zhang, Y., & Ioannou, P. (2016, May 18-20). *Environmental Impact of Combined Variable Speed Limit and Lane Change Control: A Comparison of MOVES and CMEM Model*, 14th IFAC Symposium on Control in Transportation Systems (CTS 2016), Istanbul, Turkey.

Zhao, Y., & Ioannou, P. (2016, May 18-20). *A Traffic Light Signal Control System with Truck Priority*, 14th IFAC Symposium on Control in Transportation Systems, Istanbul, Turkey.

**1.1.4 Plans for Next Reporting Period** Plans are to: 1) complete all but one of the second set of Year 2 projects; 2) continue work on the final second set year two project, 3) begin the Year 3 RFP projects, and 4) continue dissemination of research results via our website, other publications, papers, conference presentations, and our seminar series.

## 1.2 EDUCATION AND WORKFORCE DEVELOPMENT

METRANS' education goal is to foster education and training to contribute to the development of the transportation workforce. Our approach is multi-disciplinary, multimodal, and incorporates both passengers and freight. Under this grant we are developing a series of education activities, from K-12 to PhD. These programs build on the education and training programs available at both universities.

### 1.2.1 New and Continuing Activities Associated with Degree Programs

*Graduate Research Assistantships:* We reserved Year 2 funds for graduate research assistantships to support dissertations not tied to a specific research grant and to attract new PhD students. We were able to support our PhD students on other grants, and recruit new students without offering separate assistantships. These funds were therefore shifted into the research project funds.

*New Graduate Courses:* Four new Supply Chain Management courses were introduced at CSULB in the spring of 2016 as part of the new Master of Science in Supply Chain Management Degree (MSSCM) launched fall 2015. These courses are *SCM 614, Supply Chain Management; SCM 625, Global Supply Chain Strategy; SCM 630, Project Management; SCM 640, Logistics and Transportation Management. SCM 620, Business Analytics for Supply Chain Management, and SCM 699, Capstone Project for Supply Chain management* were introduced in the summer of 2016.

### 1.2.2 Facilitating Connections between Students and Employers

*Professional Development:* We continue to partner with WTS-LA to promote student participation in the resume book and to facilitate and sponsor membership and attendance at WTS events. METRANS Associate Director Victoria Deguzman is the WTS-LA chapter University Liaison, and serves on the Resume Book Committee, in both capacities conducting outreach for WTS to both high schools and institutions of higher learning throughout the greater LA region; a graduate level transportation student at USC serves as the chapter Student Liaison. A student in the CSULB Master of Science in Supply Chain Management Program serves as student liaison for the local Roundtable of the Council of Supply Chain Management Professionals and facilitates coordination between the organization and student groups including the Society for the Advancement of Management. We also continue to offer career services to students interested in a transportation related career, and facilitate connections with students and industry.

*METRANS Mentor Program:* In this program, transportation practitioners guide students to make informed career decisions and to develop into well-rounded professionals. Of the 15 students matched with mentors during the reporting period, 10 are female, and eight are both female and members of underrepresented groups (Hispanic/Latina and Asian/Pacific Islander). METRANS Associate Directors Victoria Deguzman and Thomas O'Brien also participate as mentors in the USC Price Professional Mentor Program and Deguzman participates in the WTS-OC Transportation Mentor Program, and mentors two first generation female college students.

*METRANS Lunch with a Practitioner Series:* Designed to facilitate career planning and provide guidance from and connections with practice, these events allow current transportation students to meet and learn from active transportation practitioners. Three were held during this reporting period. See below.

Date	Speakers
April 4, 2016	Greg Maher, Principal, Alta Planning and Design
	Jessica Meany, Managing Director and Founder, Investing in Place
	Tham Nguyen, Transportation Planning Manager, Metro
April 6, 2016	Michael Lin, Research Analyst, Milken Institute
Aug. 31, 2016	Stephanie Wagner, PE, PLS, President and Founder, Wagner Engineering & Survey

*METRANS Internship and Employment Assistance:* We collect and disseminate transportation internship and employment opportunities. Internships provide professional experience and often lead to jobs. Students in the USC MPL, MPA, and MPP degrees and in the CSULB MSSCM program are required to complete an internship prior to graduating. During the reporting period, students were placed at LA Metro, LA-DOT, Port of LA, Port of Long Beach, Ports of New York and New Jersey, Caltrans, LA Department of Water and Power, Foothill Transit, City of Los Angeles, CEVA Logistics, Guthy-Renker,

Wrist Marine Logistics, Fehr and Peers, Iteris, City of Beverly Hills, USC Department of Transportation, California State Legislature, Mitsubishi, Target, Google, and Torrance Transit, among others.

*CITT Job and Internship Post:* To facilitate placements, the Center for International Trade and Transportation (CITT) has also established a job and internship post, at the Manifest website: <http://www.ccpe.csulb.edu/TheManifest/calendar.aspx>. CITT also works with the CSULB Career Development Center matching students to employment and internship opportunities.

### 1.2.3 Non-degree Programs

*Metropolitan Transportation Management Certificate (MTMC):* Curriculum development has continued in coordination with Metro. The course will cover multi-modal transportation planning fundamentals, with a focus on passenger-freight conflicts and will use the development of a scope of work on a site-specific project in the City of LA. It was originally scheduled to be offered in the fall of 2016. To coordinate planning with Metro’s new Chief Planning Officer, we shifted the course to the spring of 2017.

*Caltrans Freight Academy:* In the spring 2016, CITT offered a four-day freight academy designed for planners and engineers as part of a regular series of Caltrans-specific classes. The class focused on inter-agency freight planning to reflect the role played by Caltrans in the development of a new Sustainable Freight Plan done in conjunction with the CA Air Resources Board and other state level agencies.

*Certificate in Transportation Systems:* This is an interdisciplinary program administered by the USC Department of Civil Engineering, open to graduate-level students campus-wide, combining engineering with policy, planning, and project management. During the reporting period, three students were enrolled.

### 1.2.4 Research Seminars

*METRANS Transportation Research Seminar Series:* This serves as a forum for faculty, guest presenters, and advanced graduate students to present their research. Seminars take place during the fall and spring.

<b>Date</b>	<b>Speaker(s)</b>	<b>Title</b>	<b>Cosponsor</b>
April 13, 2016	Peter Gordon, Professor Emeritus, Price School of Public Policy, USC	<i>Cities and Economic Growth</i>	APA USC
April 20, 2016	Xize Wang, PhD Candidate, Urban Planning, USC	<i>Has the Relationship Between Urban and Suburban Travel Changed?</i>	Sol Price School of Public Policy, USC
Aug. 31, 2016	Paige Zhuang, Professor, Maritime College, Ningbo University, China	<i>Port Cooperation, A Case Study from the US</i>	CITT
Sept. 7, 2016	Joseph Schwieterman Professor, DePaul University	<i>Comparing the Price &amp; Speed of CTA &amp; UberPool</i>	APA USC & USC ASPD
Sept. 21, 2016	Peter Gordon, Professor Emeritus, Price School of Public Policy, USC	<i>Agglomerations in Los Angeles</i>	Southern California Association of Governments

### 1.2.5 Educational Enrichment

METRANS offers support to transportation-related student and professional groups at USC, CSULB, and in the community to assist them with strategic planning, event planning and execution including supplying student volunteers to help with both planning and day of event staffing, membership recruitment and retention, awards, scholarships, and operations. These groups include WTS-LA, WTS-OC, ITS California, APTA, USC and CSULB Student Chapters of the Institute for Transportation Engineers (ITE), USC Student Chapter of the American Planning Association (APA), USC Price Sol Global (graduate-level students of planning policy), USC Associated Students of Planning and Development (ASPD), USC Price Women Leading Policy, Planning, and Development (WLPPD), Young

Professionals in Transportation (YPT), USC Price Partnership for an Equitable Los Angeles (PELA), USC International Public Policy and Management Program (IPPAM), CSULB Society for the Advancement of Management (SAM), the USC student chapter of the National Society of Black Engineers (NSBE) the USC and CSULB student chapters of the Society of Women Engineers (SWE), USC Asian Pacific Islander Caucus (APIC), USC Price Latino Student Association (PLSA) and the USC Price Graduate Policy and Administration Community (GPAC). We also provide opportunities for students to experience transportation outside the classroom, such as field trips, resource and guest speaker referrals, and opportunities for publication of their written work and accomplishments.

*Field Trips and Site Visits:* These are a regular component of our enrichment programming. During the reporting period, we held two half-day field trips: LA Fleet Week (private guided tours of the retired Battleship USS Iowa and the active Battleship USS America) and Foothill Transit (tour of the Operation & Maintenance Facility). In the next reporting period, we will provide behind the scenes tours of Los Angeles International Airport, Hyperloop One, and Caltrans Transportation Management Center.

*Student News and Writing Programs:* In early 2015, in response to student and employer requests for programs to address student written communication skills, we launched our student writing program, an opportunity for students to gain valuable experience as well as exposure by writing editing, and publishing timely news pieces on transportation topics of interest to both students and the community for our website in a dedicated news section. Due to the overwhelming response and success of the program, in early 2016, we launched *METRANS on the Move, Transportation News by and for Students*, a weekly student run newsletter, containing student written news as well as events (both of the center and hosted by others), and opportunities (such as internships and employment, scholarships, conference attendance and participation). Student staff has been structured to include a chief editor, topic editors, graphic designers, staff writers, and staff researchers. Distribution has grown organically, and we now send to over 2,000 recipients and in response to their requests, regularly provide space for local agencies and firms to showcase their activities and opportunities. In early 2017, we will launch four monthly, student-lead columns, cycling one for each week, featuring student written essays, student research on transportation topics of interest, op-ed type pieces, and spotlights of student and alumni accomplishments.

### **1.2.6 Attracting New Entrants to Transportation**

*Academy of Global Logistics:* In the summer of 2016, CITT entered into a partnership with the Port of Long Beach and Long Beach Unified School District to develop the Port of Long Beach Academy of Global Logistics (AGL) at Cabrillo High School. The AGL is a four-year small learning community which combines an academic curriculum with industry-relevant training and information to support academic and career development. The Academy introduces high school students to career opportunities in global trade and logistics and shows them how to prepare for those careers through a wide range of training and education programs including certificates, certifications, and degrees offered by Long Beach City College and California State University, Long Beach. CITT is responsible for developing a teacher academy that prepares Academy teachers to incorporate transportation and logistics-related materials into lesson planning, the first of which was offered in June 2016, and a summer camp for 10<sup>th</sup> graders from the Academy who are identified as student leaders and who will serve as its ambassadors with industry and the community. The first camp will be held in the summer of 2017.

### **1.2.7 Dissemination**

Dissemination is via courses and certificate programs, assistance regarding internships, employment opportunities, and professional development, seminars and educational series, our website, student research opportunities, support and outreach to student groups, research and career fair support and presentations, and our mentor program. We also use our Facebook, LinkedIn, and Twitter accounts to disseminate information and our podcasts to highlight our programs. This reporting period Twitter followers grew to 540, and Facebook followers to 523. Our LinkedIn page has 116 members, and much of

the information on METRANS programs is shared via the CITT LinkedIn site, which currently has 1,147 members.

**1.2.8 Plans for Next Reporting Period** To continue 1) professional development, student recruitment and support, and educational enrichment programs; 2) development of the Metropolitan Transportation Management Certificate, 3) Research Seminar Series; 4) Lunch with a Practitioner Series.

### **1.3 TECHNOLOGY TRANSFER**

The goal of the technology transfer program is to broaden our reach and disseminate research results.

#### **1.3.1 Continuation of Signature Events**

*International Urban Freight Conference (I-NUF)*: I-NUF 2017 will occur from October 17-20 in Long Beach. Pre-event coordination and planning will occur during the next reporting period.

The 2017 State of the Trade and Transportation Industry *Town Hall* will occur in the spring of 2017. The event will be part of a series of activities tied to the 20<sup>th</sup> anniversary of CITT, currently in development.

#### **1.3.2 Outreach Events**

*Industry Outlook*: We will hold our fourth Industry Outlook event, I Want it Now: eCommerce, Supply Chains and Transportation, on October 4, 2016 at the Doheny Memorial Library on the USC Main Campus featuring Ben Conwell, Senior Managing Director, Cushman and Wakefield.

*Working and Living in a Port City Series*: Introducing local decision makers and community residents to the port, its position in the global supply chain, and careers available in international trade and transportation, this three-part series is offered twice a year and is taught by industry professionals and a career advisor. It is supported by industry sponsorships and offered free of charge. CITT held one set of workshops in the April of 2016 and conducted outreach for another series to be held in October 2016.

#### **1.3.3 Media and Communications**

*Scholarly Venues*: Our research both contributes to knowledge and addresses transportation problems. We expect researchers to publish in scholarly journals, and require them to present at scholarly conferences. We have submitted a proposal to publish INUF 2015 papers in a special issue of *Transport Policy*.

*The CITT Industry Event Calendar*: The CITT Industry Event Calendar is an industry-sponsored portal where companies can share information with the broader community on events, internships, and employment opportunities and where we can reach an industry-focused audience via social media. We provide administrative support for the site. See <http://www.ccpe.csulb.edu/TheManifest/calendar.aspx>.

*Research Briefs*: A “Research Brief” that provides a short summary of research results suitable for a non-technical audience is required for all research projects. These briefs are widely circulated through both traditional and social media. During the reporting period seven research briefs were produced.

*METRANS News* is a tri-annual newsletter that features our research, education and outreach activities in print and online. Two issues were published during the reporting period, in the spring and summer of 2016. Over 500 copies are mailed to university transportation centers and faculty throughout the US, to federal, state, and local public agencies, and to the transportation industry. Over 1,700 recipients are emailed the link for each issue. Issues are posted on the METRANS website and on the TRB e-newsletter. As noted previously, we also publish a weekly student written newsletter (see section 1.2.5).

*METRANS Website and Social Media*: New content continues to be added to the website, and news articles and opportunities are posted weekly. The Tier 1 UTC is at [www.metrans.org/metrans-utc](http://www.metrans.org/metrans-utc). We are also active on Facebook, Twitter, and LinkedIn. We are currently creating, and in early 2017 will launch, an additional METRANS website, preliminarily titled METRANS Student Resources. It will be created and maintained by students, and designed specifically by and for students, both those considering a career in transportation and those simply interested in transportation issues. It will be hosted separately from the

main website to allow for optimal student experience and creativity but will link seamlessly from the main website as part of the main menu. This website will not only provide valuable experience for the students who create and maintain it, but will serve as a source of timely information on transportation related news and opportunities of specific interest to students and recent graduates.

*METRANS InfoShop*: The InfoShop, designed to be a queryable database, has been merged with the METRANS blog. Members of the METRANS media/outreach team are working with METRANS researchers to adapt their research briefs into informational “ask-the-expert” editorial products. Two recent special blog series have focused on a response to a Los Angeles Times article on declining transit ridership in LA, and on the various impacts of the Hanjin Shipping bankruptcy.

*ContainerCasts*: These are webcasts focused on topics of interest to the international trade community and feature discussions based on O’Brien’s *Long Beach Business Journal* articles. Two ContainerCasts were produced and posted during the reporting period. Episodes are available at [www.ccpe.csulb.edu/citt](http://www.ccpe.csulb.edu/citt).

*TransCasts*: TransCasts are podcasts featuring interviews with researchers and transportation experts. Two were posted during the reporting period. Episodes are at <https://www.metrans.org/transcasts>.

*Student Podcasts*: Student-generated podcasts are produced and posted bi-monthly, highlighting news and events of particular interest to students. Episodes are available at <https://soundcloud.com/metrans>.

*YouTube*: METRANS Seminars are available on YouTube. The full METRANS Playlist URL is [http://www.youtube.com/results?search\\_query=mtrans+transportation+center](http://www.youtube.com/results?search_query=mtrans+transportation+center).

*Trade and Transportation Perspective*: O’Brien writes the Trade and Transportation Perspective monthly column for the *Long Beach Business Journal*. Seven articles were produced during this reporting period and can be found at <http://www.ccpe.csulb.edu/citt/default.aspx?PID=10>.

**1.3.4 Dissemination** Dissemination is through events, media, and communication channels.

**1.3.5 Plans for Next Reporting Period.** Plans for the next reporting period include to: 1) continue to publish METRANS research reports and briefs to the website; 2) continue to publish news; 3) enhance and expand the website; 4) continue social media programs and grow subscriber database; 5) offer the series on Working and Living in a Port City 6) continue the InfoShop/Blog.

## **2. Products**

### **2.1 PUBLICATIONS**

In this reporting period, the Tier 1 projects have resulted in 3 peer-reviewed publications (and 15 under review) and 7 presentations (and 6 under consideration for presentation). See Section 1.1.3.

**2.2 WEBSITES.** Our website is at <http://www.metrans.org>. It is described in section 1.3.3.

**2.3 TECHNOLOGIES.** Nothing to report.

**2.4 INVENTIONS.** Nothing to report.

**2.5 EDUCATIONAL PRODUCTS.** We introduced seven new graduate courses.

### **2.6 OTHER PRODUCTS**

Other products are 1) the freight landscape database; 2) podcasts of METRANS seminars; 3) internship and employment database; 4) Long Beach Business Journal column publications and related podcasts; 5) podcast of Industry Outlook; 6) METRANS news, and 7) expansion of the Monitoring the Ports database.

## **3. Participants and Collaborating Organizations**

Participants contribute to the work of the Center through financial or other support, or directly in research. Collaborating organizations participate in Center activities, provide advisement, or support the center.



### 3.1 PARTICIPANTS

Table 8: METRANS UTC Partners and Contributions		
Name	Location	Contribution
AAA (Auto Club)	Los Angeles	Financial contribution
Aerospace Corporation	Los Angeles	Associate, financial contribution
CITT	CSULB	Home of CSULB METRANS, training and professional education programs, METRANS offices
Ceres Terminals	Los Angeles	Associate, financial contribution
Caltrans	Sacramento	Match fund sponsor, financial contribution of full required match, data sharing, other research funding
Economics Dept.	CSULB	Participating faculty, education programs, students
Engineering (COE)	CSULB	Participating faculty, education programs, students
Majestic Realty	Industry	Associate, financial contribution
Metro	Los Angeles	Assoc., financial contribution, internships, research funding
Metrolink	Los Angeles	Associate, financial contribution
Port of Long Beach	Long Beach	Assoc., financial contribution, internships, scholarships
Port of LA	Los Angeles	Assoc., financial contribution, internships, scholarships
Price School	USC	Home of Center, education programs, financial contribution
SCAG	Los Angeles	Assoc., financial contribution, internships, data sharing
SCAQMD	Diamond Bar	Financial contribution
Viterbi School Engineering	USC	Participating faculty, education programs, students; indirect cost and tuition cost share, METRANS labs
WTS LA Chapter	Los Angeles	Financial contribution

Caltrans is the major funding partner. Additional financial support is provided by METRANS Associates, and by individual corporate contributions.

### 3.2 COLLABORATING ORGANIZATIONS

METRANS has extensive relationships with other universities, public agencies, and private industry. The METRANS UTC has access to these relationships.

#### 3.2.1 Advisory Organizations

*METRANS Advisory Board:* The board meets annually, and provides overall policy guidance for the Center. It suggests research priorities, identifies funding opportunities, assists in student job placements, and participates in outreach activities. Members are leaders and serve as liaisons to their agencies and industries. They are appointed by the Director with the advice of the Executive Committee. Gold and Silver level METRANS Associates are members of the Board; others are appointed to represent the broad constituency of stakeholders. A list of members is available at <http://www.mettrans.org/advisory-board>. The Board met last in February, 2016 and will meet again in November, 2016.

*The Center for International Trade and Transportation (CITT):* CITT is dedicated to delivering education programs, innovative research, and community outreach in goods movement and is the Long Beach home for METRANS. CITT Executive Director, Thomas O'Brien serves as a METRANS Associate Director. The CITT has several noteworthy educational programs directly related to the Tier One Center, including the Academy of Global Logistics teacher course and the recently launched *Introduction to Logistics and Supply Chain Management*, a 30-hour online class that can serve as a gateway class for a number of CITT programs or as an independent self-paced training program. CITT also continues to offer *Principles of Supply Chain Management*, a 36-hour class offered in partnership with Long Beach City College as part

of a Trade Adjustment Act grant from the Dept. of Labor. The class is targeted at potential entry-level supply chain employees who have lost their jobs as a result of economic restructuring, and helps prepare them for a certification recognized by the Council of Supply Chain Management Professionals.

*CITT Policy and Steering Committee:* The CITT Policy and Steering Committee (PSC) consists of representatives from modal transportation sectors, units of government, organized labor, and other individuals in international trade and transportation, as well as from academia. The PSC helps direct the outreach activities of CITT, including those sponsored by METRANS. The PSC also serves as the advisory body on the development of the structure and content of the Town Hall Meeting.

*Other Relationships:* We have extensive relationships with industry and government. SCAG provides regional planning and transportation modeling data. LA Metro funds a major research project to develop a data archive from real-time transportation system monitoring data and develop applications for planning and system management. Several trade organizations offer scholarships and other assistance, including the Los Angeles Transportation Club (LATC), Harbor Transportation Club (HTC), Harbor Association for Industry and Commerce (HAIC), and Council of Supply Chain Management Professionals (CSMCP). The HAIC, LATC and HTC have endowed scholarship funds for students in CITT-related programs. O'Brien serves as a Board member for the Southern California Roundtable of the CSCMP, LATC, and Foreign Trade Association. During the reporting period, he was appointed Vice-Chair of the Southern CA Regional Transit Training Consortium and to the advisory board of the National Transit Institute.

### **3.2.2 Relationships with Other Universities**

*Council of University Transportation Centers (CUTC):* Giuliano is a past president and executive committee member. O'Brien is Treasurer and lead for the CUTC workforce development efforts.

*MetroFreight (MF) Center of Excellence:* METRANS is the home of the Volvo Research & Educational Foundations (VREF) Center of Excellence on urban freight. The consortium includes the University Transportation Research Center (Region 2 UTC) in New York, the Institute of Science and Technology for Transport in Paris, and the Korean Transport Institute (KOTI) in Seoul. We are concluding Year 4 of the 5-year contract with VREF. Fifteen research projects are completed and 27 are in progress. Research briefs and final research reports are posted on the METRANS website, along with the Urban Freight Curriculum Guide, periodically updated. MF's collaborative graduate course in Urban Freight was offered for the first time in spring 2016 by CCNY Alison Conway and Genevieve Giuliano. The MF team met in Seoul, Korea in July and hosted an *International Seminar on City Logistics: Challenges and Strategies for Sustainable Urban Freight*. In September, partners Geraldine Knatz, Thomas O'Brien, and Jean-Paul Rodrigue wrote on the bankruptcy of Hanjin Shipping, South Korea's largest shipping company, for the *METRANS Perspectives Blog*.

*National Center for Sustainable Transportation (NCST):* METRANS is a partner in the NCST consortium, led by UC Davis, and including UC Riverside, Georgia Tech, and University of Vermont. METRANS' role is sustainable freight transport. An additional open solicitation for NCST projects was included in our Year 3 RFP issued during this reporting period. See section 1.1.2.

*Southwest Transportation Workforce Center (SWTWC):* METRANS is home to SWTWC, one of five regional centers that form the National Network for the Transportation Workforce. FHWA funded the centers to build strategic partnerships and engage regional and national stakeholders to develop a skilled and career-ready transportation workforce. O'Brien serves as Director of SWTWC, which includes the following partner institutions: Sol Price School of Public Policy, Texas A & M University Transportation Institute (TTI), ICF International, and the National Occupational Competency Testing Institute. SWTWC facilitates results-driven partnerships with State DOTs, State Departments of Education, industry, and others throughout transportation, education, labor, and workforce communities.

*Other Activities:* With university partners, METRANS submitted several major proposals during this reporting period. We continue to work with a consortium led by U Antwerp on port innovation research.

## **4. Impact**

### **4.1 DEVELOPMENT OF THE PRINCIPAL AND OTHER DISCIPLINES**

METRANS is a multi-disciplinary research center that includes engineering, social sciences, urban planning and public policy. Our impact has been on developing interdisciplinary courses and degree programs. At USC, most graduate transportation courses are cross-listed between public policy and engineering. At CSULB, the masters level MS-SCM is an interdisciplinary degree. Employers recognize the value of our graduates' multidisciplinary training, which is reflected in high placement rates of our graduates. Regarding fields of research, METRANS has contributed to development of routing and scheduling methods to improve rail and truck efficiency; development of simulation models for truck and passenger flows; and establishing urban freight as a field of research within urban planning/public policy.

### **4.2 DEVELOPMENT OF HUMAN RESOURCES**

*Student Support:* At USC, METRANS UTC research funds one undergraduate, 20 master's, and 17 PhD students. Fourteen master's and three undergraduate students work on outreach activities. At CSULB, METRANS UTC research funds six undergraduate and 14 master's students. Three students work on METRANSInfo and social media, and three students work at SWTWC. We provide financial and administrative support to allow students to participate in transportation conferences and competitions.

*Support for Underrepresented Groups:* We are committed to promoting diversity. Of the 17 student administrative assistants at USC directly supported by METRANS funding, 14 are members of an underrepresented groups and twelve are female. Of the eight student assistants at CSULB directly supported by METRANS funding, three are female and five are members of an underrepresented group. Of the 38 students METRANS UTC research funds, seven are from underrepresented groups and five are female. Of the 14 student and professional groups supported by METRANS, three are specifically devoted to women, and three are specifically devoted to underrepresented groups. The Academy of Global Logistics at Cabrillo High School in Long Beach serves a largely minority population.

*Scholarship Opportunities:* METRANS regularly disseminates information regarding opportunities for scholarships to students and the general public via our website, social media, announcements at courses and events, and our email distribution list of over 3,000. Scholarships are generally awarded at the end of each academic year to facilitate the students' following year. Four endowments are dedicated to students in CITT-related programs, most of which serve professional students in non-credit programs who do not qualify for many other scholarship opportunities limited to degree granting programs.

*Opportunities for Research:* Student support is an important component of research project selection. Twenty-three faculty and 48 student researchers participate in these projects.

*New Educational Materials and Programs and Opportunities for Teaching:* We began development for the second session of the LBUSD Teacher Training course to be offered June 2017. Several additional courses and programs are under development, and offer teaching opportunities for instructors from industry to share their experiences with students in both credit and non-credit programs.

### **4.3 RESOURCES AT UNIVERSITY AND PARTNER INSTITUTIONS**

We continue support of transportation student and professional organizations, and to improve our Goods Movement Database, the Manifest Industry Outlook calendar, and the internship and employment databases. METRANS continues to develop the METRANS InfoShop/Blog. At USC, research facilities include staff offices, high capacity computing, spatial analysis laboratory, secure data servers, and a variety of statistical software.

#### **4.4 TECHNOLOGY TRANSFER.**

Tech transfer is via reports, briefs, papers, and presentations.

#### **4.5 SOCIETY BEYOND SCIENCE AND TECHNOLOGY**

Our faculty are editors and on boards of several scholarly journals, and are members of state or local committees and task forces, providing advice on transport policy and practice. Giuliano is a member of the National Freight Advisory Committee and contributed to recommendations for a national freight strategic plan, and for the freight provisions in the FAST Act. She is a member of the California Freight Advisory Committee, which provides advisement at the state level. O'Brien is a member of the TRB Intermodal Freight Transport Committee and the Intermodal Freight Terminal Design and Operations Committee. CITT Director of Research Tyler Reeb serves on the TRB Education and Training Committee. Giuliano and O'Brien developed white papers used in the development of the California Sustainable Freight Action Plan, and are members of the state's Freight Efficiency Study Group which will provide advisement on the implementation of the Plan. O'Brien helps to raise the profile of transportation workforce development at the regional and national levels and brings together stakeholders from the public sector and private industry as Director of SWTWC and through the CUTC Workforce Development Committee. Boarnet consulted with the Strategic Growth Council of the State of California to develop a white paper on Vehicle Miles Traveled (VMT) reduction to inform the revision of the State of California scoping plan for Greenhouse Gas (GHG) reduction. Painter consulted with YearUp, to address the transportation constraints of geographic location for low income youth as a barrier to employment opportunities.

#### **5. Changes.**

No changes in the scope or objectives of this grant.

#### **6. Special Reporting Requirements.**

No special reporting requirements.