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Signature of Submitting Official	

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 aimed at increasing the economic competitiveness of large metropolitan areas through improved transportation system performance across all surface transportation modes, passenger and freight. By developing strategies that promote productivity and better integrate modes and users, METRANS contributes to more efficient, sustainable metropolitan transportation.

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, which examines the basic forces underlying transport supply and demand. It has 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. It explores the potential for efficiencies within and across modes and user classes and identifies 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.

Table 1: Year 1 Launch Projects			
Theme 1	Understanding Passenger-Freight Interactions	Status	Funding
Topic 1-1	Spatial Patterns and Transportation		
1-1a	<i>Urban Spatial Structure, Employment Sub-Centers, and Passenger and Freight Travel</i>	Completed	Caltrans
1-1b	<i>The Freight Landscape: Using Secondary Data Sources to Describe Metropolitan Freight Flows</i>	Completed	USDOT
Topic 1-3	Better Data for Analysis of Passenger-Freight Interactions		
1-3a	<i>Tracking Truck Flows with Programmable Mobile Devices</i>	Completed	Caltrans
Theme 2	Achieving System Efficiencies	Status	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>	Completed	USDOT
2-1b	<i>Design and Evaluation of Impact of Traffic Light Priority for Trucks on Traffic Flow</i>	Completed	USDOT
Topic 2-2	Policies for More Efficient Urban Transportation		
2-2	<i>Mitigating Urban Freight Through Effective Management of Truck Chassis</i>	Completed	Caltrans

Year 1 Launch Project Progress Reports

USC 1-1a: Urban Spatial Structure, Employment Sub-Centers, and Passenger and Freight Travel (Boarnet, USC) (8/25/2014 - 5/15/2016 (no cost extension)). Project is complete. The impact of polycentric metropolitan development patterns on passenger traffic and freight flows is poorly understood. We examine freight traffic along the road network in LA to assess how the sub-centered pattern of employment is associated with freight flows. Our initial literature review indicated a much

larger gap in understanding freight flows and employment sub-centers so we focus on that question and do not examine passenger travel. The results indicate that employment is an important driver of freight activity, and employment subcenters have an independent effect on freight activity. We disseminated the results of this research by presenting a poster based on the work at the 2016 Transportation Research Board meetings and by presenting a paper at the Western Regional Science Association.

USC 1-1b: The Freight Landscape: Using Secondary Data Sources to Describe Metropolitan Freight Flows (Giuliano, USC) (1/1/2014 – 9/30/2015 (no cost extension)). Project is complete. This research develops a method for describing the spatial variation in freight supply and demand within metropolitan areas using widely available data. We hypothesize that spatial distribution of freight activity is related to the spatial organization of economic activities. We estimate models of freight activity as a function of local and regional spatial characteristics. Scope was modified to reflect data availability. We estimated two sets of models, one using categorical dummy variables as measures of development intensity, and the other using employment and population characteristics. Each generated similar and consistent results. We find a significant relationship between development intensity and truck flows, supporting the concept of “freight landscape” as a proxy for freight flows. Population and employment density is generally spatially correlated, but varies across metro areas. Higher correlation is observed for LA and San Francisco. Differences in spatial patterns may be linked to economic structure. We use these spatial patterns to show how the general contours of freight activity may be imputed.

CSULB 1-3a: Tracking Truck Flows with Programmable Mobile Devices for Drayage Efficiency Analysis (Lam, CSULB) (8/25/2014 - 10/31/2015). Project is complete. Inefficient use of drayage trucks results in pollution and congestion. A full measure of current and future drayage efficiency can only be obtained through detailed tracking of drayage activities. Our tracked activities covered 12 terminals at the Twin Ports providing services on the heavy container corridor, to near-dock rail facilities and warehouses of a major retailer, and for general store delivery. Findings from these data include: (i) the average turn times range from 56 minutes for “deliver load” single moves to 126 minutes for “deliver empty and pick up load” dual moves, with an overall average of 88 minutes; (ii) the average speeds on the paths that the trucks traveled are 26-39% below Google estimated ideal speeds, with the slowdown on the heavy container corridor being most significant; (iii) the amount of travel drivers spent on truck repositioning range from 12% to 46%; and (iv) “pick up load” is the dominant type of work that drivers go to the ports for, with the combination of “pick up load”, “deliver empty & pick up load”, and “deliver load & pick up load” account for 64% of all transactions in our tracking. Through our experiment we also observed that counting on accurate and timely inputs by all drivers all the time is unrealistic. Hence, for any tracking to be widely adopted, the logging of events must be fully automated without driver interaction.

USC 2-1a: Efficiencies in Freight and Passenger Routing and Scheduling (Dessouky, USC) (1/1/2014 – 6/30/2015). The project is complete. We evaluated and scenario tested the solution approach (Task 4) and submitted the final report (Task 5). We performed simulation experiments on well-known benchmark problem instances in the literature. For each, we compare the quality of our solution with other routing strategies and see that the look-ahead routing strategy with forecasting of future requests outperforms a routing strategy that only makes use of the known demand information, in terms of total travel distance for instances with relatively fewer advance requests and more dynamic requests. This routing strategy showed merits for problems with 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) (1/1/2014 – 7/31/2015). The project is complete. We developed two strategies for traffic light control that take into account the two different classes of vehicles (trucks and other) in areas where the truck volume is relatively high. The other vehicles include light-duty and passenger vehicles. The first approach is based on estimating the average traffic delays using a neural network approach. The delay is the difference between the ideal and actual travel times of vehicles. We evaluated the proposed model using MATLAB and VISSIM software. The simulation results for a 9 intersection network where trucks constitute 20% of the traffic volume indicate that the average delay of all vehicles is reduced by 25%

while the number of truck stops is reduced by 61% compared to the traffic light control approach that treats all vehicles the same. The traffic light strategy is currently under evaluation using a realistic traffic network in an area close to the ports of Los Angeles/Long Beach.

CSULB 2-2: Mitigating Urban Freight through Effective Management of Truck Chassis (O'Brien, CSULB) (8/25/2014 - 12/31/2015). The project is complete. This project assesses the potential benefits of shared chassis management at the Ports of Los Angeles and Long Beach as well as the jurisdictional and institutional issues surrounding coordinated equipment management procedures. Chassis storage has typically occurred at maritime terminals and rail yards. Ocean carriers operating in the US have traditionally owned the chassis and provided them to truckers for their use in transferring containers between the ports, distribution and intermodal facilities. Truckers are then required to reposition the chassis back to the terminal. Carriers have recently shed chassis ownership. The research findings suggest that the effectiveness of a pooled chassis strategy depends in part upon the kind of transaction involved (import, export, empty container) and that it has not eliminated the repositioning of equipment between terminals to ensure equipment availability. One of the major results of the analysis is that most stakeholders see the shared equipment strategy as a temporary solution that will ultimately be replaced by a business model in which the truck driver or trucking company manages and maintains the equipment as owner or under a long-term lease. Additionally, chassis inspections have created an uncertain and contentious environment from a labor perspective.

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

Table 2: Year 1 Open Solicitation Projects			
Theme 1	Understanding Passenger-Freight Interactions	Status	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>	Completed	Caltrans
14-13	<i>Smart Truck Driver Assistant: A Cost Effective Solution for Real Time Management of Container Delivery to Trucks</i>	Completed	Caltrans
Theme 2	Achieving System Efficiencies	Status	Funding
Topic 2-1	Integrated Management Across Users and Modes		
14-09	<i>A Dynamical Framework for Integrated Corridor Management</i>	Completed	Caltrans
14-11	<i>Vehicle-to-Vehicle Communications in Mixed Passenger – Freight Convoys</i>	In Progress	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 Transportation Systems</i>	Completed	Caltrans

Year 1 Open Solicitation Project Progress Reports

CSULB 14-06: Development of Micro Wireless Sensor Platforms for Collecting Data of Passenger-Freight Interactions (Mozumdar, CSULB) (1/1/2015 - 12/31/2015). The project is complete. We developed an in-node microprocessor-based approach to analyze and determine the types of vehicles passing over a 3-axis magnetometer sensor. Our approach for vehicle classification utilizes a J48 classification algorithm implemented in Weka. The decision tree model is generated externally from the microprocessor using features extracted when vehicles pass over the sensor, provided to the algorithm to generate a decision tree model with classification rates based on cross-validation, implemented using nested if-loops in any language on a multitude of microprocessors. Setting an adaptive baseline to account for the background magnetic field allows reuse of the same model in multiple environments. The result shows that the vehicle classification system is effective and efficient with accuracy above 98%. We developed a prototype sensor node with a form factor of 30mm x 30mm or roughly the size of a quarter.

CSULB 14-13: Smart Truck Driver Assistant: A Cost Effective Solution for Real Time Management of Container Delivery to Trucks (Englert, CSULB) (1/1/2015 - 12/31/2015). The project is complete. We used a system that tracks truck movements outside and inside port terminals and

measures turn times using GPS, network antenna and the inertial sensors of truck drivers' smartphones at no additional cost. We developed a prototype and completed testing. Our algorithms analyze data to derive models of cargo traffic flow in and around terminals. Our mobile phone application provides information to drivers and port and terminal authorities, ensuring use by port stakeholders and allowing us to collect needed data, which can be employed to build a comprehensive database on port transportation. We developed and tested a mobile application for stakeholders to track truck movements. 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) (1/1/2015 - 12/31/2015). The project is complete. We extended our case studies on the downtown LA subnetwork to include a resilience comparison between proportionally fair (PF) and max pressure (MP) algorithms. In particular, our simulation study suggests that the average travel times are smaller under PF during an incident. We formulated the freeway network control (FNC) problem, and clarified its relationship with respect to the system optimum dynamic traffic assignment problem. We showed that if the running cost is total traffic volume, the network consists only of ordinary or diverging junctions, demand and supply functions have identical slopes and magnitude on all links, then an optimal solution to FNC corresponds to the FIFO traffic dynamics, in the sense of the cell transmission model. We also developed robustness bounds, shown to be 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) (1/1/2015 - 12/31/2015). This project is in progress. We investigate characteristics of radio propagation channels in scenarios where both trucks and passenger cars are on the road, i.e. either between cars and trucks or between cars whose connection is blocked by trucks. We have been working on the following: 1) Writing software-defined radio units for customized codes to fully control their behavior during measurements. Both transmitting and receiving antenna arrays have also been successfully calibrated in an anechoic chamber and the whole measurement set-up has been successfully tested in controlled environments; 2) Measurement campaigns have been minutely prepared (vehicles – including passenger cars and trucks –, scenarios, environments, measurement set-up, logistics, etc.) and are being conducted; 3) A geometry-based stochastic channel model has been developed for mixed vehicle-to-vehicle and truck-to-truck radio propagation channels and is being parameterized based on the measured data; 4) Physical (PHY) and Medium Access Control (MAC) layers of the IEEE 802.11p standard have been implemented in MATLAB. Performance for the measured channels is being estimated and compared with the ones found in the literature.

USC 14-04: Analysis and Prediction of Spatiotemporal Impact of Traffic Incidents for Better Mobility and Safety in Transportation Systems (Shahabi, USC) (1/1/2015 - 12/31/2015). The project is complete. We studied global learning and incremental learning methods for time-dependent latent attributes. To improve efficiency of global learning, we implement an incremental algorithm to sequentially and adaptively learn the latent attribute from the temporal graph changes. With extension of our global and incremental learning algorithm, we learned (1) real-time feedback information can be seamlessly incorporated into our framework to adjust for the existing latent space, thus allowing for more accurate predictions; (2) our algorithms train and make predictions on-the-fly with the incoming data without requiring mass historical data. In this period, we evaluated our algorithms with a large volume of real-world traffic sensor data for scenarios with and without accidents. The experimental results show that our techniques accurately predict traffic speed with 10% deviation with the ground-truth value, improving existing time series prediction techniques by 25%. We observe that the performance gain of our proposed algorithm over existing methods is larger than that without accidents. In addition, we concluded that our batch window setting works perfectly for streaming data, alternating the executions of our global and incremental algorithms, which strikes a compromise between prediction accuracy and efficiency.

[Year 2 Open Solicitation Research Program](#). The Year-2 RFP was issued Dec. 2014 and included a general solicitation for projects within Center themes and a list of specific projects (also within the

themes) from Caltrans. All tenure track and research faculty at USC and CSULB were eligible to submit proposals; 15 complete proposals were received and 10 were funded. See Table 3 below.

Table 3: Year 2 Open Solicitation Projects, RFP No. 1			
Theme 1	Understanding Passenger-Freight Interactions	Status	Funding
Topic 1-2	Characteristics of Freight and Passenger Demand		
15-10	<i>Route Choice Characteristics of Owner-Operated Trucks in Southern California Freeways</i>	Active	Caltrans
15-15	<i>The Decline in Inter- and Intra-Urban Mobility and its Impact on Passenger Travel</i>	Active	Caltrans
Theme 2	Achieving System Efficiencies	Status	Funding
Topic 2-1	Integrated Management across Users and Modes		
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>	Active	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 LA</i>	Active	Caltrans
Caltrans	Transportation Planning Freight Planning		Funding
15-01	<i>Investigations of the Effect of Humid Air on NOX & PM Emissions of a CNG Engine</i>	Active	Caltrans
15-02	<i>Simulation of liquefaction-induced damage of the Port of Long Beach using the UBC3D-PLM model</i>	Active	Caltrans
15-03	<i>Development of an Economic Framework to Evaluate Resilience in Recovering from Major Port Disruptions</i>	Active	Caltrans
Caltrans	Rail and Mass Transportation Rail Planning		Funding
15-04	<i>Integration of Passenger and Freight Rail Scheduling</i>	Active	Caltrans

Because few proposals addressed Caltrans topics, a second 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 7 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. 2			
Theme 1	Understanding Passenger-Freight Interactions	Status	Funding
Topic 1-1	Relationships Between Spatial Patterns and Transportation		
15-27	<i>Spatial Dynamics of Warehousing and Distribution in California</i>	Active	Caltrans

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). The objectives are to investigate the effect of a humid air system on nitrogen oxides (NOx) and Particulate Matter (PM) emissions of a compressed natural gas (CNG) engine. Experiments have shown that medium- and heavy-duty vehicles running on natural gas have lower PM, NOx, and non-methane hydrocarbon emissions, as compared to diesel and gasoline vehicles. A humid air system or fumigation has been shown to be an effective approach in reducing NOx emissions of diesel engines; water vapor is injected into the intake air supplied for combustion, reducing the local temperature in the cylinders and raising the specific heat of the air-fuel mixture. With decreased temperature, NOx emissions are reduced, and the humid air system could substantially reduce NOx emissions without significant increase in hydrocarbon emissions. The investigation has two parts. The first is numerical modeling of the CNG combustion with dry input air as well as input air with different levels of humidity. Numerical modeling and simulations with humid air inputs at three different humidity

levels have been completed. Non-premixed combustion in a single cylinder was simulated using the presumed probability density function combustion model. Results indicate approximately 53% reduction in NO emission with 5% humidity, however, there was an increase of more than 30% in CO emission. With 10% humidity, the NO emission is reduced by 72% while the CO is increased by 49%. Additional simulations for 15% and 30% humidity levels are in progress to find optimized humidity level for experimental evaluations. Humid air system for the engine tests has been fabricated. Preparation of the experimental set-up is ongoing and we anticipate starting engine tests in May 2016.

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). 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. In the past decades, port facilities have been expanded by placing hydraulic fills behind rock retention dikes. These loose man-made fills and even their subjacent natural estuarine and marine deposits have shown to be susceptible to liquefaction. The analyses of the information regarding the subsurface exploration of the port are finished. This includes the evaluation of liquefaction susceptibility computing factors of safety against liquefaction using currently available published semi-empirical approaches that are based on field tests, mainly Standard Penetration and Cone Penetration Tests. Conclusions have been drawn regarding the onset of liquefaction and the resulting settlements after the dissipation of excess pore water pressures in the post-earthquake stages. The final stage is an evaluation of the liquefaction effects of a hypothetical structure placed on top of the ground surface and the effects when subjected to the proposed earthquake motions. The research team already started to write the first draft of the final report with the numerical model description and calibrations. Conclusions, observations, and recommendations obtained in this project are being used to fulfill the final objective of this research, understanding 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 study develops 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. We extend and adapt a computable general equilibrium (CGE) model and apply it to quantify the relative contributions of various resilience options in mitigating potential economic impacts from port disruptions. During this reporting period, we reviewed the literature on port resilience and found that most studies focused on supplier-side (rather than customer) resilience and few attempted to quantify the effectiveness and cost of the resilience tactics. We developed an analytic framework to identify and evaluate the relevant set of economic resilience options to port disruptions on both supplier-side and customer-side, and identified the approach to incorporate them formally into the CGE models. For the Case Stud, we have completed the simulations for the Base Case (without resilience considerations). The simulation results indicate that about half of the economic impacts stemming from the disruptions of three major ports in California caused by the USGS Tsunami Scenario will take place in the three-county region of POLA/POLB and about 1/3 of the impacts in the San Francisco nine-County region. Next, we work on simulations of the effects of port resilience strategies in terms of their respective potential to reduce economic losses from disruptions. We formulate policy recommendations to enhance economic resilience based on our research findings and write the final report.

USC 15-04: Integration of Passenger and Freight Rail Scheduling (Dessouky, USC) (8/15/2015 – 8/14/2016). This project develops 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 will investigate the impact and potential benefits of integrating the scheduling of these two types of trains. We will use the rail network from Downtown Los Angeles to Colton as our test case. We have completed task 1 (updating the train data sets and literature review) and task 2 (modifying a simulation model to existing

rail trackage). We are almost finished with task 3 (algorithmic development) and have started task 4 (validation and experimental comparison of the proposed algorithm with existing methods).

USC 15-08: Application of a Regional Multi-Modal Transportation System Performance Monitoring Framework (Giuliano, USC) (8/15/2015 – 8/14/2016). This research examines the characteristics and explanatory factors associated with intra-metropolitan variation in highway and arterial system performance. Better understanding of performance variation will support more effective transportation system management. Our study consists of three parts. 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. Second, 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. We continue tasks 1 and 2. We have downloaded highway traffic data, and are downloading arterial traffic data. We are performing data quality checks, cleaning/filtering, and have scheduled a meeting with Caltrans D7 to discuss highway data issues. We have collected and analyzed attributes of various road network datasets, and are using updated network configuration data for this study. We have performed a new cluster analysis of the highway system (and are testing alternative ways), and developed a methodology of clustering the arterial system (work ongoing). We have also worked out a detailed methodology of performance variation analysis.

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 developing a full research design to evaluate route choice characteristics used by owner-operated trucks when choosing from two or three different types of roads. Shipper responses to travel cost, reliability on-time arrival, comfort, convenience, safety, and ownership are important to understand shipper behaviors and to aid in developing appropriate strategies and incentives for better managing shared systems. The work includes: 1) critical literature review; 2) clear and detailed statement of objectives for the stated preference survey; 3) development of a survey instrument; 4) identification of the sample population; 5) proposed methodology for generating a representative sample of respondents; and 6) pilot test. We have completed critical literature review and summarized key information to show how the existing studies relate to the project work. Using GIS software, Google Maps, and Caltrans website information, the freeways of interest and various distribution centers from the ports of Long Beach and Los Angeles were visualized to look closely at all interstate and state routes in LA County. The project team also designed and administered a preliminary questionnaire that provided us with useful information about truck drivers, and more specifically, the population of interest, while acting as a preliminary training session for student assistants who will administer a full-scale questionnaire and/or survey. More importantly, the project team has 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.

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). During the last period we formulated the problem as an optimization problem in addition to developing the simulator for testing and evaluating the proposed techniques. The nonlinear optimization problem which is hard to solve is converted into a pointwise-in-time linear optimization problem that is easy to solve. The information needed at point of time is generated by the on line simulator. We developed a method how to use the optimization results to reallocate freight to different links by using a gradient technique to make changes in a direction that further minimizes the overall cost. We will next evaluate the developed method using the simulator based on realistic scenarios. These evaluations will be used to consider ways to improve the method further by either reformulating the optimization problem or changing the gradient approach for faster reduction in cost at each iteration. We also plan to examine scalability and speed of response to incidents and unexpected events that cause significant disruptions.

USC 15-13 Development of Affordable Housing Guidelines near Rail Transit in Los Angeles (Bostic, USC) (8/15/2015 – 8/14/2016). Since our last report, we have made significant progress on this

project. We completed building the typologies for the project as well as the models that estimate the impacts of different development patterns on housing affordability and greenhouse gas emissions. Having both of these, we were able to demonstrate the utility of our research by simulating what would happen if Los Angeles pursued two different development strategies around their rail transit stations. This work culminated in a working paper, which we have presented at seminars at the Furman Center at New York University and the Department of Urban Studies and Planning at California State University – Northridge. We also presented this at the Association of Collegiate Schools of Planning national conference in Houston. We incorporated the feedback from these presentations into a revised working paper, which we submitted to a journal (*Journal of the American Planning Association*) in March 2016. While we await word from the journal, we continue to review our analytical models. In addition, we are devoting effort towards identifying ways that we might expand the approach to further refine this analysis.

USC 15-14: Quantifying the Impact of Next-Generation Modes of Delivery (Carlsson, USC) (8/15/2015 – 8/14/2016). 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 of these services 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. This project will 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 the first three tasks of our proposal, namely a literature review, an analysis of multi-stop trips, and an analysis of multi-stop trips to study the amount of adoption of delivery services necessary in order for social benefits to be realized. We are working on the fourth task, studying temporally-varying demand and the impacts of profit maximization.

USC 15-15: The Decline in Inter- and Intra-Urban Mobility and its Impact on Passenger Travel (Painter, USC) (8/15/2015 – 8/14/2016). This project consists of three parts: 1) analyze the characteristics and implications of declining US migration trends, 2) conduct empirical analyses to determine how the current trend affects urban passenger travel demand, and 3) discuss strategies to help achieve national/regional transportation policy goals considering current population dynamics. Task 1 focuses on understanding whether the changing demographic composition of the U.S. is related to the decline in mobility. We analyze the most recent changes, and document the determinants, magnitudes, and characteristics of the decline in inter- and intra-urban mobility and continue data analysis. Task 2 is to analyze whether consideration of past/current population migration trends allows us to better model and hence more reliably forecast urban passenger travel demand. 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. Depending on our findings, we will consider whether we need to extend the national study to an intra-urban (LA region) analysis of travel behavior and trends. 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 the remaining research funding from the METRANS Tier 1 funds, including remaining funds from previous years.

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:

- B. Englert, “A Smartphone-Based Truck Monitoring System for the Ports of LA and Long Beach.”
- B. Englert, M. Aliasgari, S. Asgari. , “Smart Truck Driver Assistant: A Cost Effective Solution for Real Time Management of Container Delivery to Trucks”, in preparation for journal submission.
- G. Como, E. Lovisari, and K. Savla (2016). Convexity and Robustness of Dynamic Traffic Assignment for Control of Freeway Networks, Transportation Research Part B: Methodological, under review.
- G. Giuliano, G. S. Kang, and J. Yuan (2015) “Using proxies to describe the metropolitan freight landscape”, revise and resubmit for Urban Studies.
- G. Painter, and S. Chakrabarti, “How Does Population Migration Affect Travel Demand? An Analysis of Transit Ridership across U.S. Metropolitan Areas Over 2006-2013” (Working title), in preparation for *Transportation Research Part A: Policy and Practice*.
- J. Carlsson, “Household-Level Economies of Scale in Transportation,” accepted for publication in forthcoming issue of *Operations Research*.
- K. Savla, “Distributed Algorithms for the Dynamic Network Traffic Assignment,” tentatively planning submission for *IEEE Transactions on Control of Networked Systems*.
- K. Savla, “Throughput Optimality of Proportionally Fair Traffic Signal Control Policies under General Phase Architectures,” planning submission for *SIAM Journal on Control and Optimization*.
- M. Boarnet, A. Hong, R. Santiago-Bartolomei, Urban Spatial Structure, Employment Subcenters, and Freight Travel, under submission at *Journal of Transport Geography*
- M. Dessouky, and H. Zou, “A Look-Ahead Routing Strategy for Solving the Dynamic Vehicle Routing Problem.”
- R. Bostic, S. Rodnyansky, R. Santiago-Bartolomei, “Environmentally Sustainable and Affordable Housing Near Transit in Los Angeles”, submitted to the *Journal of the American Planning Association* in March 2016
- Y. Zhao, F. Vital, P. Ioannou and T. Rajabioun, “A Traffic Light Priority System for Trucks and Its Impact on Traffic Flows” submitting to *IEEE Transactions on Intelligent Transportation Systems*.

The following were published:

- A. Abadi, P. Ioannou and M. M. Dessouky, “Multimodal Dynamic Freight Load Balancing”, *IEEE Trans. on ITS*, Feb. 2016, Vol. 17, no. 2, pp. 356-367
- G. Como, E. Lovisari, and K. Savla (2015). “Convex Formulations of Dynamic Traffic Assignment for Control of Freeway Networks”, Allerton Conference on Communication, Control and Computing, Monticello, IL
- G. Nilsson, P. Hosseini, G. Como, and K. Savla (2015). “Entropy-like Lyapunov Functions for Stability Analysis of Adaptive Traffic Signal Control”, *Proceedings of the IEEE Conference on Decision and Control*, Osaka, Japan, pages 2193-2198
- K. Ying, A. Ameri, A. Trivedi, D. Ravindra, D. Patel, M. Mozumdar, “Decision Tree-based Machine Learning Algorithm for In-node Vehicle Classification”, *Proceedings of IEEE Green Energy and Systems Conference*, Long Beach, November 2015, USA

- P. Hosseini, and K. Savla (2016). "A Comparison Study Between Proportionally Fair and Max Pressure Controllers for Signalized Arterial Networks", Transportation Research Board Annual Meeting, Washington DC. Paper number 6738.
- Q. Ba, K. Savla, and G. Como, (2015). Distributed Optimal Equilibrium Selection for Traffic Flow over Networks, *Proceedings of the IEEE Conference on Decision & Control*, Osaka, Japan, pp 6942-6947

The following were recently submitted for conference presentation.

- G. Giuliano, "Application of the Los Angeles Archived Data Management System (ADMS) to analyze intra-metropolitan variation in highway and arterial system performance", submitted for the 56th Annual Conference of the Association of Collegiate Schools of Planning
- L. G. Arboleda-Monsalve, J. Mercado, A. Sover, and D. G. Zapata-Medina, (2016). "Liquefaction of a Major U.S. Port Facility using the UBC3D-PLM Constitutive Soil Model," Submitted for possible publication and presentation to GeoFrontiers 2017, March 12-15, Orlando, FL.
- T. O'Brien, "Trucking Regulation as a Critical Supply Chain Asset in Port Complexes," submitted for presentation at the 14th Conference on World Congress on Transport Research in Shanghai, China, July 2016.

During this reporting period, the following were presented:

- C. Shahabi, U. Demiryurek, "Analysis and Prediction of Spatiotemporal Impact", METRANS Seminar, Feb.10, 2016
- D. Preciado, N. Avila, and L. G. Arboleda-Monsalve (2015), "Simulation of Liquefaction-induced damage of the Port of Long Beach using the UBC3D-PLM model," Poster presented at California State University Program, HSI-STEM Summer Bridge at the Beach, Long Beach, California, 2016.
- G. Giuliano, "Spatial Dynamics of Warehousing and Distribution in California", University of Antwerp: March 2016, Antwerp, Belgium
- G. S. Kang, "Spatial Dynamics of Warehousing and Distribution in California", International Urban Freight Conference (I-NUF), Oct 2015, Long Beach, CA
- G. S. Kang, "Spatial Dynamics of Warehousing and Distribution in California", ACSP Annual Conference, Oct 2015, Houston, TX
- L. G. Arboleda-Monsalve "Numerical Simulation of Liquefaction in a Major Port Facility using UBC3D-PLM Model," Los Angeles Geo-Institute Chapter (ASCE), City of Commerce, California, 2016.
- M. Boarnet, E. Hong, and R. Santiago-Bartolomei, "Urban Spatial Structure, Employment Subcenters, and Freight Travel," submitted to Transportation Research Board (TRB) Annual Meetings (2016), for presentation and publication
- M. Mozumdar, "Development of Micro-Wireless Sensor Platforms for Collecting Data of Passenger-Freight Interactions", METRANS Seminar, Nov.18, 2015
- P. Ioannou, Invited Speaker for IPAM program on Traffic Modeling, UCLA, October 26-27, 2015
- P. Ioannou, Invited Speaker Traffic Flow Management Culminating Workshop, IPAM, Lake Arrowhead, 12/6-12/11/2015
- S. Lam, "Tracking Truck Flows with Programmable Mobile Devices for Drayage Efficiency Analysis", International Urban Freight Conference (I-NUF), Oct, 2015, Long Beach, CA
- S. Lam, "Tracking Truck Flows with Programmable Mobile Devices for Drayage Efficiency Analysis", METRANS Seminar, Nov.14, 2015
- V. Sharma, A. Parhad, M. Mozumdar, "Energy Scavenging Using Piezoelectric Sensors to Power in Pavement Intelligent Vehicle Detection Systems", International Urban Freight Conference (I-NUF), Oct 2015, Long Beach, CA

1.1.4 Plans for Next Reporting Period Plans are to: 1) complete the last Year 1 open solicitation project and the first set of Year 2 projects; 2) continue work on the project awarded from the second Year 2 RFP, 3) award and 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. Traditional discipline-based education and training is not sufficient for current and future workforce demands; 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.*

New Undergraduate Minor and Coursework under Development: The CSULB Department of Civil Engineering/Construction Engineering Management and CITT continue to develop an undergraduate minor degree in transportation in the College of Engineering (COE). The COE has proceeded with hardware procurement for establishment of a Remote Desktop Service for engineering drivers and software for development of online education and is working on the curriculum.

1.2.2 Facilitating Connections between Students and Employers

Professional Development: We continue to partner with WTS-LA to promote student participation in the WTS-LA resume book and to facilitate and sponsor membership and attendance at WTS events. METRANS Assistant Director Victoria Deguzman is the 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. During the reporting period, we selected our 2015 Student of the Year, a Latino first-generation college student, and provided financial assistance for him to attend the awards banquet and the weeklong TRB conference in Washington DC. We also offer career services to students interested in a transportation related career, facilitate connections with students and industry, and host on-campus opportunities for professional photographs.

METRANS Mentor Program: In this program, transportation practitioners (mentors) guide students to make informed career decisions and to develop into well-rounded professionals. We have continued our year-over-year growth. Of the 25 mentees matched during the reporting period, 15 are female, and three are both female and members of underrepresented groups (Hispanic/Latina).

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. Five were held during this reporting period. See below.

Date	Guest(s)	Title/Topic
10/7/2015	William Kelly, President/CEO Kelly Associates Management Group	<i>Transportation Consulting and Holding Public Office</i>
11/4/2015	Matthew Benjamin, Principal Fehr & Peers	<i>Transportation Careers in the Private Sector</i>
2/17/2016	John Lower, Associate Vice President, Iteris, Inc.	<i>Transportation “Plangineering”</i>

2/19/2016	Karl Fielding, Lead Planner, WSP Parsons Brinckerhoff	<i>Connecting and Transforming California: California High- Speed Rail</i>
	Tony Mendoza, Planning Manager WSP Parsons Brinckerhoff	
	Kevin Alvarado, Public Involvement Specialist, WSP Parsons Brinckerhoff	
3/4/2016	Steven Mateer, Transportation Planning Manager Los Angeles Metro	<i>Transportation Careers in the Public Sector</i>

METRANS Internship and Employment Database: Internships provide professional experience and often lead to jobs. All transportation students are encouraged to secure internships. During the reporting period, students were successfully placed in transportation internships at include LA Metro, the LA-DOT, the Port of Los Angeles, the Port of Long Beach, Fehr and Peers, Iteris, the City of Beverly Hills, USC Department of Transportation, California State Legislature, Mitsubishi, Target, and Torrance Transit. We also collect and disseminate information regarding transportation employment opportunities.

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. We have developed a proposal to work with LA Metro to pilot the first class with its employees. The course will cover multi-modal transportation planning fundamentals, with a focus on passenger-freight conflicts. The course will use the development of a scope of work for a planning consultant on a site-specific project in the City of Los Angeles as a framework. The course will be offered in fall 2016.

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 semesters, are open to the public, and are often a collaborative effort of METRANS and cosponsors such as student, academic, and professional groups. Many are recorded and made available through social media. Seminars are well attended, with attendance during the reporting period of nearly 400. See below.

Table 6 METRANS Research Seminars held during the reporting period			
Date	Speaker(s)	Title	Cosponsor
10/24/2015	I-Hung Khoo, Professor Department of Electrical Engineering, CSULB	<i>Noise Mapping of Container Terminals at the Ports of Long Beach & Los Angeles</i>	<i>Center for International Trade and Transportation (CITT)</i>
	Tang-Hung Nguyen, Professor Dept. of Civil Eng. and Construction Eng. Management, CSULB		
11/5/2015	Burkhard Englert, Chair Department of Computer Science, CSULB	<i>Tracking Truck Movements at the Ports of Long Beach & LA</i>	<i>Center for International Trade and Transportation (CITT)</i>
11/11/2015	Donald Shoup, Professor Department of Urban Planning, UCLA	<i>Politically Popular Parking Meters: A Progress Report on Parking Reforms</i>	<i>USC Price International Policy, Planning, and Management Program and Partnership for Equitable LA</i>

11/14/2015	Shui Lam, Professor, CSULB Computer Engineering & Computer Science Department,	<i>Tracking Truck Flows With Programmable Mobile Devices for Drayage Efficiency Analysis</i>	<i>Center for International Trade and Transportation (CITT)</i>
11/18/2015	Mohammad Mozumdar, Assistant Professor Department of Electrical Engineering, CSULB	<i>Development of Micro- Wireless Sensor Platforms for Collecting Data of Passenger- Freight Interactions</i>	<i>USC Student Chapter of the Institute for Transportation Engineering</i>
12/2/2015	Antonio Bento, Professor Price School, USC	<i>Cars that Kill?The Effect of Fuel Economy Standards on Vehicle Weight Dispersion and Safety</i>	<i>USC Student Chapter of the American Planning Association (APA)</i>
2/10/2016	Cyrus Shahabi, Director Integrated Media Systems Center, USC	<i>Analysis and Prediction of Spatiotemporal Impact</i>	<i>USC Viterbi School of Engineering</i>
	Ugur Demiryurek, Associate Director, Integrated Media Systems Center, USC		
2/23/2016	Williams Riggs, Asst Prof. College of Architecture and Env. Design, Cal Poly SLO	<i>Urban Design and Street Typology: Do They Matter</i>	<i>USC Price Urban Growth Seminars</i>
2/24/2016	Jean-François Cordeau, Professor, Department of Logistics and Operations Management, HEC Montréal	<i>Benders Decomposition for Production Routing Under Demand Uncertainty</i>	<i>USC Sonny Astani Department of Civil & Environmental Engineering</i>
3/2/2016	Genevieve Giuliano, Professor Price School, USC	<i>Is Los Angeles Becoming Transit- Oriented?</i>	<i>Associated Students of Planning and Development at USC</i>
	Eun Jin Shin, Doctoral Student Price School, USC		
3/9/2016	Paige Zhuang, Professor Maritime College, Ningbo University, China	<i>Regional Governance of a Port in China</i>	<i>Center for International Trade and Transportation (CITT)</i>

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, membership recruitment and retention, awards, scholarships, and operations. These groups include WTS-LA, WTS-OC, USC Student Chapter of the Institute for Transportation Engineers (ITE), USC Student Chapter of the American Planning Association (APA), Price Sol Global (graduate-level students of planning policy), Price Women Leading Policy, Planning, and Development (WLPPD), Young Professionals in Transportation (YPT), Price Partnership for an Equitable Los Angeles (PELA), International Public Policy and Management Program (IPPAM), the USC student chapter of the National Society of Black Engineers (NSBE) the USC student chapter of the Society of Women Engineers (SWE), USC Asian Pacific Islander Caucus (APIC), Price Latino Student Association (PLSA) and the 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.

METRANS on the Move: is a weekly, student generated (written and produced), student-focused newsletter that features transportation news, events, and opportunities of interest to students. Typical news pieces include newly published research results, student awards and activities, and summaries of

METRANS events. The newsletter also includes a section devoted to transportation-related opportunities, including upcoming events such as seminars, field trips, programs, conferences, meetings, networking opportunities; job and internship postings; scholarships; training; and fellowships. The newsletter is distributed in electronic form to approximately 2,500 students, faculty, staff, practitioners, public agencies, and private firms, and is increasingly seen as a valuable tool of information dissemination for both academic and professional groups to reach a wide, diverse, and engaged audience.

Field Trips and Site Visits: During the reporting period, METRANS held 3 half-day field trips: 1) LA Metro (tour of the Operation Center) 2) Foothill Transit (tour of the Operation & Maintenance Facility). 3) Caltrans (tour of the Transportation Management Center).

1.2.6 Attracting New Entrants to Transportation

Virtual Transportation Academy: We are developing courses as part of a Virtual Transportation Academy to provide opportunities for high school students to get college level credit for what could lead to an undergraduate minor degree in transportation in CSULB's COE. The program starts with an introductory class offered online which facilitates access for qualified senior high school students. This program has become a part of the undergraduate transportation specialization described above. (See Section 1.2.1.)

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. We average over four posts a day on the Facebook page and two Tweets per day via Twitter. This reporting period Twitter followers grew to 227, and Facebook followers to 233. The Twitter account averages 265 impressions per day (appearances on user feeds). Our LinkedIn page has 113 members, and much of the information on METRANS programs is shared via the CITT LinkedIn site, which currently has 1,141 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): We hosted the 6th I-NUF, from October 21-23, 2015 in Long Beach. More than 120 presentation abstracts were received. Special sessions and/or meetings were sponsored by the TRB Urban Freight and Intermodal Freight Transport Committees, and by the Young Members Council. Presentations were featured in the Nov. 2015 FHWA *Talking Freight* webinar series.

The 2016 State of the Trade and Transportation Industry *Town Hall*, March 30, CSULB: Themed "Partners in Innovation," the panel discussed how supply chain stakeholders are working together to identify innovative solutions that improve supply chain efficiency and effectiveness. The speakers represented marine terminal operations, port management, trucking, cargo owners, and labor and addressed incentives for stakeholders to work together to make the supply chain more transparent and the regulatory environment either encourage or discouraging innovation. An educational video produced by CSULB's Advanced Media Production team opened the event.

1.3.2 Outreach Events

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 careers advisor. It is supported by industry sponsorships and offered free of charge. CITT held one set of workshops in November 2015 and conducted outreach for another series to be held in April 2016.

Boot on the Ground, Flats in the Boardroom: Transportation Women Tell Their Stories. We held a special event on campus during this reporting period, a panel discussion featuring Grace Crunican, General Manager, Bay Area Rapid Transit; LaVerne Francis Reid, Former Airports Division Manager, Federal Aviation Administration; Dana Hook, Vice President, CDM Smith; Mengzhao Hu, Senior Transportation Planner, KOA Corporation; and James E. Moore, II, Professor, Vice Dean Viterbi School of Engineering, USC. Panelists shared their transportation career insights with a capacity crowd of over 150 students and practitioners at the USC Doheny Memorial Library the evening of March 23, 2016.

1.3.3 Media and Communications

Scholarly Venues: We conduct research that 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 are submitting papers presented at I NUF 2015 to *Transport Policy* for a special issue.

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, the following research briefs were produced: *Efficiencies in Freight and Passenger Routing and Scheduling to Reduce VMT* (Dessouky), *Mitigating Urban Freight through Effective Management of Truck Chassis* (O’Brien).

METRANS News is a tri-annual newsletter that features the research, education and outreach activities of METRANS, in both print and online. The most recent issue was published in the fall of 2015. Over 500 copies are mailed to university transportation centers and faculty throughout the U.S., 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.

METRANS Website and Social Media: New content continues to be added to the website, and news articles (often written by transportation students) and opportunities are posted on a weekly basis. The Tier 1 UTC is at www.metrans.org/metrans-utc. We are also active on Facebook, Twitter, and LinkedIn.

METRANSInfo: The InfoShop, designed to be a queryable database, is being 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.

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. Four ContainerCasts was produced and posted during the reporting period. Episodes are available at www.ccpe.csulb.edu/citt.

TransCasts: TransCasts are podcasts featuring interviews with METRANS researchers and other distinguished transportation experts – Six were posted during the reporting period. Five focused on the research presented at the 2015 I NUF Conference. 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.

Trade and Transportation Perspective: O’Brien writes the Trade and Transportation Perspective monthly column for the *Long Beach Business Journal*. Five 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 achieved through the events, media, and communication channels described above.

1.3.5 Plans for Next Reporting Period. Plans for the next reporting period include to: 1) continue to publish completed METRANS research reports and briefs to the website; 2) continue to publish news including regular email blast updates; 3) enhance and expand the website; 4) continue social media programs and grow subscriber database for LinkedIn and followers of Twitter; 5) offer the series on Working and Living in a Port City 6) launch the new InfoShop as part of an expanded METRANS blog.

2. Products

2.1 PUBLICATIONS

In this reporting period, the Tier 1 projects have resulted in six peer-reviewed publications (and 14 under review) and 13 presentations (and three 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 six 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

Name	Location	Contribution
AAA (The Auto Club)	Los Angeles	Financial contribution
Aerospace	Los Angeles	Associate, financial contribution
CITT	CSULB	Home of CSULB METRANS, training and professional education programs, METRANS offices
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, rsch funding
Port of Long Beach	Long Beach	Assoc., financial contribution, internships, scholarships
Port of Los Angeles	Los Angeles	Assoc., financial contribution, internships, scholarships
Price School of Public Policy	USC	Home of Center, education programs, financial contribution for admin; indirect cost share; offices, labs
SCAG	Los Angeles	Assoc., financial contribution, internships, data sharing
SCAQMD	Diamond Bar	Financial contribution
Viterbi School of 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 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.metrans.org/advisory-board>. The Board met during the reporting period, specifically on February 25, 2016 at USC.

The Center for International Trade and Transportation (CITT): CITT is dedicated to delivering education programs, innovative research, and community outreach in the area of 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. For example, a Secondary Education Instructors Course, a one week short course for teachers at Long Beach Unified School District which was first offered in June 2015 and will be repeated later this year. CITT has also developed Principles of Supply Chain Management, a 36-hour (two-week) class on that has been 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 has developed an online course based upon the Principles of SCM curriculum that can be used as an introduction to the topic for any of CITT's program offerings.

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 (CSCMP). The HAIC, LATC and HTC have endowed scholarship funds for GLS students. O'Brien serves as a Board member for both the Southern California Roundtable of the CSCMP and LATC.

3.2.2 Relationships with Other Universities

Council of University Transportation Centers (CUTC): METRANS is a long-time member of CUTC. Center Director (Giuliano) is a past president and executive committee member. O'Brien is serving on the executive committee and serves as METRANS 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, which seeks to improve the sustainability of goods movement in metropolitan areas around the world. The consortium includes the University Transportation Research Center (Region 2 UTC) in New York, the Institute of Science and Technology for Transport (IFSTTAR) in Paris, and the Korean Transport Institute (KOTI) in Seoul. A total of thirteen MF research projects have been completed by the partners and 26 are continuing. We are beginning Year

4 of the 5-year contract with VREF and five new projects are being launched, four led by Paris and one by Seoul. Research briefs and final research reports are posted on the MF website. During this reporting period METRANS faculty, VREF partners, business leaders, staff and students participated in 60 interviews and a site visit with VREF representatives as part of the MetroFreight CoE Mid-term Review (October 2015). A VREF Business Meeting was held during the International Urban Freight Conference (I-NUF) in Long Beach, California (October 2015), which complemented the mid-term evaluation. A total of 58 papers from CoE researchers were presented in eight special sessions and other conference sessions. Another VREF Business Meeting was held during the Transportation Research Board Annual Meeting (January 2016) in Washington DC. Giuliano participated in the Antwerp Port Workshop, Belgium (March 2016). TRANS-Blog was launched which provides information and perspectives on urban transport issues and policies. Podcasts were introduced and continue to be offered. IFFSTAR hosted the first MetroFreight Urban Freight Training Seminar in Paris (December 2015).

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 four undergraduate, 17 Master's, and 17 PhD students. Ten 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 13 student administrative assistants at USC directly supported by METRANS funding, three are members of an underrepresented group and seven are female. Of the four student assistants at CSULB directly supported by METRANS funding, two are female and one is a member 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.

Scholarship Opportunities: METRANS regularly disseminates information regarding opportunities for scholarships to students at both universities as well as 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.

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 LBUSC Teacher Training course to be offered June 2016. Several additional courses and programs are under development, and offer teaching opportunities for ten instructors.

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, and the internship and employment databases. METRANS continues to develop the METRANS InfoShop. 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. Giuliano and O'Brien are members of the TRB Intermodal Freight Transport Committee, and developed white papers that are being used in the development of the California Sustainable Freight Action 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.

5. Changes.

No changes in the scope or objectives of this grant.

6. Special Reporting Requirements.

No special reporting requirements.