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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 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.

Tables 1 through 3 list research projects from Years 1 and 2. All projects are completed and final reports are posted on the website. Given space limitations, we do not include descriptions for the Year 1 and Year 2 projects.

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

Table 2: Year 1 Open Solicitation Projects, RFP – all are completed and posted to website	
Theme 1	Understanding Passenger-Freight Interactions
Topic 1-3	Better Data for Analysis of Passenger-Freight Interactions
14-06	<i>Development of Micro Wireless Sensor Platforms for Passenger-Freight Interactions.</i>
14-13	<i>Smart Truck Driver Assistant: Real Time Management of Container Delivery to Trucks</i>
Theme 2	Achieving System Efficiencies
Topic 2-1	Integrated Management Across Users and Modes
14-09	<i>A Dynamical Framework for Integrated Corridor Management</i>
14-11	<i>Vehicle-to-Vehicle Communications in Mixed Passenger – Freight Convoys</i>
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>

Table 3: Year 2 Open Solicitation Projects – all are completed and posted to website		
Theme 1	Understanding Passenger-Freight Interactions	Funding
Topic 1-1	Relationships Between Spatial Patterns and Transportation	
15-27	<i>Spatial Dynamics of Warehousing and Distribution in California</i>	Caltrans
Topic 1-2	Characteristics of Freight and Passenger Demand	
15-10	<i>Route Choice Characteristics of Owner-Operated Trucks in Southern California Freeways</i>	Caltrans
15-15	<i>The Decline in Inter- and Intra-Urban Mobility and its Impact on Passenger Travel</i>	Caltrans
Theme 2	Achieving System Efficiencies	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>	DOT
15-12	<i>Optimum Routing of Freight in Urban Environments under Normal Operations and Disruptions using a Co-simulation Optimization Control Approach</i>	DOT
15-14	<i>Quantifying the Impact of Next-Generation Modes of Delivery</i>	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>	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>	Caltrans
15-02	<i>Simulation of liquefaction-induced damage of the Port of Long Beach using the UBC3D-PLM model</i>	Caltrans
15-03	<i>Development of an Economic Framework to Evaluate Resilience in Recovering from Major Port Disruptions</i>	Caltrans
Caltrans	Rail and Mass Transportation Rail Planning	Funding
15-04	<i>Integration of Passenger and Freight Rail Scheduling</i>	Caltrans

We issued our Year 3 RFP (<http://www.metrans.org/research-projects/mettrans-utc>) on March 11, 2016, with proposals due April 15, 2016. We received 18 proposals and funded eight of them. The USDOT funded projects began in January 2017; the Caltrans funded projects began in March 2017. Table 4 lists the Year 3 projects, and abstracts are presented following the table.

Table 4: Year 3 Open Solicitation Projects		
Theme 1	Understanding Passenger-Freight Interactions	Funding
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
Theme 2	Achieving System Efficiencies	Funding
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
Theme 3	Policies for More Efficient Urban Transportation	Funding
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
Theme 4	Integrated Management Across Users and Modes	Funding
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
16-17	<i>Evaluating Freight Efficiency Metrics</i>	Caltrans

Year 3 Open Solicitation Project Progress Abstracts

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 directly or indirectly 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. This is 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. The research concludes with examples of some multimodal routes which may or may not benefit with CVT significantly due to poor transportation infrastructure settings that prevail in Southern California.

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 a 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. Results from that study show how both goals can be met through development that favors density over inclusionary zoning. 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 directly estimate actual changes in emissions. The third contribution of this research is its consideration of residential self-selection into neighborhoods. Very little is known about how the supply of TODs matches the latent demand for this type of neighborhood. The general argument is that residential selection may or may not be part of the total effect. We anticipate bounding the residential effect by using a propensity score match method to be able to quantify VMT change, accounting for all selection and, alternately, for none of the selection effect. The results will inform our overall model to assess net VMT and emission effects.

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. This study extends the research on the geography of opportunity in two important ways. First, 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 (Mohammad 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.

USC 16-17 Evaluating Freight Efficiency Metrics (Giuliano, USC) The purpose of this project is two-fold: to conduct an evaluation of the freight efficiency metric adopted in the California Sustainable Freight Action Plan (CSFAP), and to develop a set of supportive measures consistent with the FAST Act and California’s Freight Mobility Plan that captures more traditional efficiency performance measures for the freight sector. The research will examine the consistency and reliability of the freight efficiency metric, GDP (freight sector)/GHG (freight sector). Based on the literature, the research will develop a set of supportive freight efficiency and performance measures. Potential measures will be evaluated with respect to transparency, sensitivity to changes in freight logistics activities, sensitivity to costs and savings resulting from implementation of the CSFAP, and scalability.

We issued our Year 4 RFP (<http://www.metrotrans.org/research-projects/metrotrans-utc>) to allocate remaining research funding from the METTRANS Tier 1 funds, both USDOT and Caltrans match, including remaining funds from previous years. The Year 4 RFP was issued on March 17, 2017, with proposals due April 19, 2017 We received 14 proposals and funded six of them. Table 5 lists the Year 4 projects, and abstracts are presented following the table.

Table 5: Year 4 Open Solicitation Projects		
Theme 1	Understanding Passenger-Freight Interactions	Funding
Topic 1-3	Better Data for Analysis of Passenger-Freight Interactions	
17-11	<i>Smart Sensing System for Real-time Automatic Traffic Analysis of Highway Rest Areas</i>	DOT
Theme 2	Achieving System Efficiencies	Funding
Topic 2-1	Integrated Management across Users and Modes	
17-01	<i>Optimizing Combined Truck Routing and Parking based on Parking Availability Prediction</i>	DOT
17-02	<i>Investigating Impact of Crowdsourcing on Smart Freight Mobility</i>	DOT
17-05	<i>Socially Optimal Personalized Routing with Preference Learning</i>	DOT
Topic 2-2	Policies for more efficient urban transportation	
17-09	<i>Institutional Response to Transit Oriented Development in the Los Angeles Metropolitan Area: Understanding Local Differences Through the Prism of Density, Diversity, and Design</i>	DOT
17-14	<i>Measuring Congestion Costs of Car Commuters and Their Determinants: A Counterfactual Approach</i>	DOT

Year 4 Open Solicitation Project Progress Abstracts

USC 17-01 Optimizing Combined Truck Routing and Parking based on Parking Availability Prediction (Ioannou, USC)

In this project we plan to investigate the development of Optimum Routing and Scheduling Algorithms for Trucks based on Parking Availability Prediction. The purpose of this proposal is to develop truck routing and scheduling algorithms that incorporate predicted parking availability along possible routes that minimize cost which may include travel time, environmental costs etc under several constraints that include restrictions on hours of service and other possible government regulations as well as imposed time windows for service. An algorithm for predicting parking availability developed under a different project will be modified to be part of the overall optimization procedure. We plan to use real data currently available at several internet sites to come up with realistic scenarios to test the developed algorithms. Our focus for evaluation will be California which is one of the states with a truck parking problem however routes and parking places of neighboring states will also be considered for demonstrating the results.

CSULB 17-02 Investigating Impact of Crowdsourcing on Smart Freight Mobility (Chandra, CSULB)

This research will develop such analytical models that leverage both crowdsourced data on traffic conditions and data such as commodity flows, fuel consumption etc. of conventional freight to design operations of a smart freight system. The contribution of crowdsourcing in improving transportation efficiency in real time is evolving rapidly and qualitatively, creating the need to develop models that characterize smart freight mobility. Several smartphone applications related to traffic information and communications have seen a surge in recent times, however, with missing developments in artificial intelligence needed to cause forward looking solutions to smart transportation needs, particularly for freight. A sequence of four interrelated objectives aptly define the approach, which are as follows: (1) Identifying sources of available conventional freight data – such as commodity flow, truck volume, air cargo volume etc. across all modes, (2) Integrating crowdsourced data with conventional freight truck data for model building, (3) Building stochastic models for mobility that characterize smart freight, and finally, and (4) Estimating efficiency (in fuel consumption, ton-miles traveled etc.) from the predictive capabilities of the models for smart freight system.

USC 17-05 Socially Optimal Personalized Routing with Preference Learning (Vayanos, USC) The objective of this project is to improve routing efficiency (e.g., minimize aggregate delay, congestion, or pollution) in real-world transportation networks by proposing personalized socially optimal routes that are likely to be adhered to by the commuters. Spurred by rapid population growth and city development, traffic congestion has become inescapable in metropolitan areas across the U.S. and its direct and indirect effects can be dire. Indeed, congestion can severely impede quality of life, negatively impact health and productivity, and increase commuting costs and pollution. At the same time, support for increased taxation to fund expansion of the existing road network to meet current and future needs is in short supply. For these reasons, it is imperative to find novel ways to improve routing efficiency over the existing infrastructure. We propose to (a) develop a machine learning framework for learning individual driver preferences over time, (b) devise a mathematical model and solution scheme for computing personalized equilibrium routes given limited and imperfect information on the driver preferences, (c) leverage this model to compute personalized implementable socially optimal routes, (d) quantify the reduction in the Price of Anarchy achieved by our framework in stylized problems, and (e) showcase the performance of our approach on real data.

USC 17-09 Institutional Response to Transit Oriented Development in the Los Angeles Metropolitan Area: Understanding Local Differences Through the Prism of Density, Diversity, and Design (Banerjee, USC) The objective of the proposed study is to examine local initiatives and institutional responses to transit developments, their evolution over the last 25 years, and the extent to which institutional responses to promote transit neighborhood idea have been explored, developed, and implemented. Drawing on Los Angeles County's diverse institutional, political, and socio-economic landscape, what inferences can be drawn about local governments' response to the design and planning of transit-oriented developments (TODs), their relative success, and future outlook? What lessons might we glean about the essential performance characteristics for designing a transit neighborhood from the short yet dynamic history of transit expansion in metropolitan Los Angeles? We are interested in knowing how city governments have responded to usual expectations of commensurate TOD in the Los Angeles metropolitan region. Ultimately, this research will result in identifying locally driven best practices in station area development and a better understanding of institutional and policy responses and the role of community values and participation affecting land use near transit stations.

CSULB 17-11 Smart Sensing System for Real-time Automatic Traffic Analysis of Highway Rest Areas (Mozumdar, CSULB) This research proposal targets the design of smart sensing system for real-time automatic traffic analysis of highway rest areas. We will develop low-power sensing platforms, optimized power-saving algorithms, communications protocols, and machine-learning models to yield a novel and modular multi-nodal sensing systems that will help traffic analysis of highway rest areas efficiently. This will be a part of nationwide efforts of Intelligent Transportation Systems (ITS) for smart connected roads. To the best of our knowledge, Caltrans (or similar entity at nationwide) doesn't have any installed ITS that can perform "automatic" and "real time" vehicle identification and classification for highway rest areas. Our proposed system will reveal high grained traffic data such that user will be able to know for "each" vehicle the time of entry and exit in the rest area and, it's classification (based on axles). The proposed smart sensing and data interpretation system will maintain small foot-print, significantly cost-effective (compare to existing available systems), and will be capable of automatic identifying and classifying each vehicle in high way rest area in real-time. This research will focus on all levels of system design from architecture to computation to communication design.

CSULB 17-14 Measuring Congestion Costs of Car Commuters and Their Determinants: A Counterfactual Approach (Kim, CSULB) Although the theory of traffic congestion has become one of the main themes in the field of transportation economics, empirical research quantifying the social cost of congestion is relatively rare. The main goal of this research is to fill that gap by providing new evidence on the social costs of traffic congestion, and to identify their determinants for guiding congestion-reduction policies. In this project, we measure commuters' wasted time due to traffic congestion using a unique dataset that measures the trips and characteristics of individual commuters. We develop a new approach to measuring congestion delays, which is simple to estimate and widely applicable. Specifically, we first estimate how much time each commuter would have spent if she had experienced no congestion delays on her route. We then compare this counterfactual travel time to the commuter's actual travel time and compute the difference. We exploit recent developments in econometrics to measure congestion costs in this manner.

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 were published in refereed journals: (11)

- Boarnet, M., Giuliano, G., Hou, Y., & Shin, E.-J. (September 2017) *First/last mile transit access as an equity issue*, Transportation Research A, Policy and Practice. vol. 103, 296-310.
- Boarnet, M., Hong, A., & Santiago-Bartolomei, R. (April 2017) *Urban Spatial Structure, Employment Subcenters, and Freight Travel*. Journal of Transport Geography, vol. 60, pp. 267-276.
- Choi, J.-H., & Painter, G. (May 2017) *Self-Reported vs. Market Estimated House Values: Are Homeowners Misinformed or Are They Purposely Misreporting*, Published in Real Estate Economics.
- Fu, L., & Dessouky, M. (July 2017) *Algorithms for a Special Class of State-Dependent Shortest Path Problems with an Application to the Train Routing Problem*. Journal of Scheduling
- Giuliano, G. S. Kang, and J. Yuan (2017) "Using proxies to describe the metropolitan freight landscape", *Urban Studies*, first published online: February 1, 2017, <https://doi.org/10.1177/0042098017691438>.
- He, S. and G. Giuliano (2017) School choice: Understanding the trade off between travel distance and school quality, *Transportation*, published online February 2017, <https://doi.org/10.1007/s11116-017-9773-3>.
- Hu, L and G. Giuliano (2017) "Job accessibility, poverty concentration, and employment outcomes", *Journal of Urban Affairs*, 39(1), 1-16. Published online 1/4/17.
- Li, S., Dessouky, M., Yang, L. & Gao, Z. (May 2017) *Joint Optimal Train Regulation and Passenger Flow Control Strategy for High-Frequency Metro Lines*. Transportation Research Part B: Methodological. vol. 99, 113-137
- Rodrigue, J-P, L. Dablanc, G. Giuliano (2017) "The freight landscape: Convergence and divergence in urban freight distribution," *Journal of Transport and Land Use*, 10(1), <https://jtl.u.org/index.php/jtlu/article/view/869>.
- Wang, R., Renaudin, O., (et al.) (August 2017) *High resolution parameter estimation for time-varying double directional V2V channel*. Published in IEEE Transactions on Wireless Communications
- Wang, R., Bas, C.U. (et al.) (May 2017). *A real-time MIMO channel sounder for vehicle-to-vehicle propagation channel at 5.9 GHz*, pp. 1-6. Published in IEEE International Conference on Communications (ICC).

The following papers are under review or under preparation for a journal submission: (19)

Ba, Q. & Savla, K. *Optimal Control of Traffic Flow over Networks: Distributed Computation & Sparsity*
Bostic, R., Boarnet, M., Rodnyansky, S., & Santiago-Bartolomei, R. *Environmentally Sustainable and Affordable Housing Near Transit in Los Angeles* under submission at the Journal of the American Planning Association

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

Chiang, Y., Shahabi, C., (et al.) *LA-Metro Bus Data Analysis Using GPS Trajectory Data and Schedule Data*

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.*

Hosseini, P. and Savla, K. *Steady-state Computation and Offset Optimization using Rectangular Approximation for Signalized Arterial Networks*

Hou, Y., Giuliano, G., Kang, S., Shin, J-S. *Polycentricity and the evolution of metropolitan spatial structure* presented at WRSA 2016 and in preparation for journal submission.

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.

Shao, Y. & Dessouky, M. *A Hybrid Heuristic Method for the Compressed Natural Gas (CNG) Truck Routing Problem with Fueling Stations*, under revision to Transportation Research Part E: Logistics and Transportation Review

Schuetz, J., G. Giuliano, E-J Shin (2017) "Is Los Angeles becoming transit oriented?", under review, *Cityscape*.

Schuetz, J., G. Giuliano, E-J Shin (2017) Does zoning help or hinder transit-oriented (re)development?, second R&R under review, *Urban Studies*.

R. Wang et al., *Optimal Array Switching Sequence for the TDM Channel Sounding in a Fast Time-varying Channel.*

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

Zhang, Y., & Ioannou, P. *Comparison of Feedback Linearization and Model Predictive Techniques for Variable Speed Limit Control.*

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

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

The following were submitted for conference presentation (7):

Boarnet, M., Bostic, R., (et al.) (2017, October 12-17) *The Joint Effects of Income, Vehicle Technology, and Transit-oriented Development on Greenhouse Gas Emission.* Association of Collegiate Schools of Planning Annual Conference.

Carlsson, J., Dessouky, M., & Zou, H. (2017, October 22-25) *An Online Cost-sharing Mechanism for Horizontal Supply Chains.* INFORMS 2017 Annual Meeting in Houston, TX.

Wang, R., Renaudin, O. (et al) (2017, October 8-13) *Vehicle-to-Vehicle Propagation Channel for Truck-to-Truck and Mixed Passenger Freight Convoy.* International Symposium on Personal, Indoor and Mobile Radio Communications, IEEE 2017. Montreal, QC, Canada

- Wang, R., Renaudin, O., (et al.) (2018, May 20-24) *Antenna Switching Design for Channel Sounding in a Fast Time-varying Channel*. submitted to IEEE International Conference on Communications (ICC) 2018. Kansas City, MO.
- Wei, D., Chen, Z., & Rose, A. (2017, October 17-20) *Evaluating the Role of Resilience in Recovering from Major Port Disruptions*. For 7th METRANS International Urban Freight Conference, Long Beach, CA.
- Zhang, Y., & Ioannou, P. (2017 Oct. 16-19). *Comparison of Feedback Linearization and Model Predictive Techniques for Variable Speed Limit Control*. IEEE 20th International Conference on Intelligent Transportation Systems, Yokohama, Japan.
- Zhao, Y., & Ioannou, P. (2017 Oct. 16-19). *A Hierarchical Co-Simulation Optimization Control Framework for Multimodal Freight Transportation Routing*. IEEE 20th International Conference on Intelligent Transportation Systems, Yokohama, Japan

The following were presented (7):

- Chandra, S. (2017, September 18-20) *Multimodal freight operations in a connected vehicle environment*, ITS California Annual Conference and Exhibition
- Li, Y., Su, H., Demiryurek, U., Shahabi, C. (et al) (2017, April 3-7) *PaRE: A System for Personalized Route Guidance*. 26th International Conference on World Wide Web. Perth, Australia.
- Mercado, J., Arboleda-Monsalve, L., Zapata-Medina, D., & Star, L. (2017, June 4-7). *Probabilistic Evaluation of Earthquake-Induced Settlements of the Port of Long Beach using Classical Approaches*. Lecture presented at GeoRisk 2017: Geotechnical Risk from Theory to Practice in Geo-Institute-ASCE, Denver.
- Wang, R., Bas, C.U., (et al) (2017, May 21-25) *A real-time MIMO channel sounder for vehicle-to-vehicle propagation channel at 5.9 GHz*. Communications (ICC), 2017 IEEE International Conference. Paris, France.
- Wang, R., Renaudin, O., (et al) (2017, September 24-27) *Double-Directional Channel Characterization of Truck-to-Truck Communication in Urban Environment*. 2017 IEEE 86th Vehicular Technology Conference (VTC-Fall). Toronto, ON, Canada
- Yu, R., Li, Y., Shahabi, C., Demiryurek, U., & Liu, Y. (2017, April 27-29) *Deep Learning: A Generic Approach for Extreme Condition Traffic Forecasting*. 2017 SIAM International Conference on Data Mining. Houston, TX
- Zhang, Y., & Ioannou, P. (2017 July 9-14). *Coordinated Variable Speed Limit, Ramp Metering and Lane Change Control of Highway Traffic*. IFAC 2017 World Congress, Toulouse, France.

1.1.4 Plans for Next Reporting Period Plans are to: 1) complete work on the Year 3 RFP projects; 2) work on the Year 4 RFP projects; and 3) 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 continue to support PhD students on METRANS research projects.

Postdoctoral Fellowships: Two postdoctoral fellowships were awarded for the 2017-18 academic year. Sanggyun Kang, 2017 USC PhD, will conduct research on warehouse location and impacts, and on freight flow optimization. Yanbo Zhao, 2017 USC PhD, will conduct research on freight flow optimization.

New Graduate Courses: The new CSULB Master of Science in Supply Chain Management Degree (MSSCM) launched in the fall of 2015. The program has two parallel tracks, one for practicing professionals, which is an evening and weekend program completed in 24 months. The other is an accelerated track for those not working in the industry as well as international students. This track is completed in 21 months. The first cohort of MSSCM (Accelerated) graduated in the summer of 2017.

Undergraduate Programs: CSULB is still waiting approval for CITT's Global Logistics Specialist Program for 6 units of 400-level undergraduate study as part of CSULB's degree-completion Bachelor of Arts in Liberal Arts (BALA) program. The program will target at students who have accumulated 70 units of community college credits. The GLS tie-in will provide working professionals without an undergraduate degree an opportunity to secure a BA while studying industry-specific content.

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 a Special Advisor to the President of Workforce Development, and conducts 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 and the Graduate Business Association. We also continue to offer career services to students interested in a transportation related career, and facilitate connections with students and industry. CSULB also designs the employer engagement programs for the Port of Long Beach Academy of Global Logistics at Long Beach Cabrillo High School.

METRANS Mentor Program: In this program, transportation practitioners (mentors) guide students to make informed career decisions and to develop into well-rounded professionals. Twenty-one students were mentored during the reporting period (16 female, 13 both female and members of underrepresented groups - Hispanic/Latina and Asian/Pacific Islander).

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.

METRANS Internship and Employment Assistance: We collect and disseminate information regarding transportation internship and employment opportunities. Internships provide professional experience and often lead to jobs. Students in the MPL, MPA, and MPP degrees at USC and in the MSSCM Accelerated program at CSULB completed internships prior to graduating. During the reporting period, students were placed at LA Metro, LA DOT, Port of LA, Port of Long Beach, Caltrans, LA Department of Water and Power, Foothill Transit, City of LA, Fehr and Peers, Culver City, Southern California Association of Governments (SCAG), KOA, Hyperloop, USC DOT, California State Legislature, and Google, among others.

CITT Job and Internship Post: CITT has established a job and internship post on its website at <https://www.ccpe.csulb.edu/TheManifest/JobPostings.aspx> and works with the CSULB Career Development Center matching students to employment and internships .

1.2.3 Non-degree Programs

Metropolitan Transportation Management Certificate (MTMC): Curriculum development was coordinated with LA Metro and designed to cover multi-modal transportation planning fundamentals, with a focus on passenger-freight conflicts. The class was conducted in four sessions which started on Feb. 10 and concluded on March 3. The success of this pilot program has motivated the METRANS team to further develop its curriculum and share it as an educational tool for planning and transportation professionals around the country.

Caltrans Freight Academy: CITT offers a four-day freight academy designed for planners and engineers as part of a regular series of Caltrans-specific classes. During the reporting period, classes were in development for two offerings to be held in the spring of 2018, one focusing on intermodal transport to be held in Ontario CA and the other on agricultural supply chains to be held in Sacramento.

Introduction to Logistics and Supply Chain Management: a self-paced 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 was completed in 2016 and is now part of CITT's course offerings. Students who complete the class are eligible for a waiver of the introductory module in the Global Logistics Specialist program.

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

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. Most are recorded and made available through social media. Seminars are well attended. The research seminars held during this period were funded through the new Pacific Southwest Region UTC.

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 and CSULB Student Chapters 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), Associated Students of Planning and Development (ASPD), 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), CSULB Society for the Advancement of Management (SAM) and Graduate Business Association, 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), 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.

Field Trips and Site Visits: These are a regular component of our enrichment programming. The field trips are now being phased into the new PSR UTC funds.

1.2.6 Attracting New Entrants to Transportation

Academy of Global Logistics: In summer of 2016, CITT partnered 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 CSULB. CITT is responsible for developing an academy to prepare teachers to incorporate transportation and logistics-related materials into lesson planning. During the reporting period, CITT worked on curriculum development for the third academy as well as a 10th grade summer camp for Academy Ambassadors, originally planned for summer 2017. The camp was postponed to summer 2018 in order to develop new curriculum details. During the camp, students will be offered the opportunity to take a certification test in introductory supply chain management principles offered through Long Beach City College and CSULB. CITT also conducts industry-teacher-student mixers throughout the year.

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 825, and Facebook followers to 877. Our LinkedIn page has 1,261 members, and much of the information on METRANS programs are shared via the CITT LinkedIn site, which currently has 1,155 members and serves as the CITT alumni network. We also feature METRANS related events at the CITT blog, which is available at <https://www.ccpe.csulb.edu/citt/blog/blogposts.aspx?pID=125>.

1.2.8 Plans for Next Reporting Period. As of Fall 2017, all education and workforce development activities transition to PSR and will be reported under the PSR grant.

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. We anticipate 220 attendees. The link is available [here](#).

The 2017 State of the Trade and Transportation Industry Town Hall took place on March 30, 2017. The event was part of a series of activities tied to the 20th anniversary of CITT. The event drew approximately 160 attendees. Information on the event, including an archived version of the event itself, can be found at the CITT website.

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 career advisor. It is supported by industry sponsorships and offered free of charge. CITT plans to hold a seminar series in Spring 2018.

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. A proposal to *Transport Policy* for a special issue featuring papers presented at I NUF has been accepted and is currently in development.

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 <https://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, one research brief was 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 2017. Nearly 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 2,132 recipients are emailed the link for each issue. Issues are posted on the METRANS website and on the TRB e-newsletter. Between METRANS News issues, we circulate bi-weekly email blasts for both METRANS and CITT with important updates on our research, education and community engagement programs.

METRANS on the Move is a weekly, e-newsletter written and produced by students under the guidance of the Associate Director, Deguzman. More than 3,000 subscribers receive this weekly publication containing transportation news, and notice of transportation events and opportunities, such as conferences, seminars, webinars, scholarships, internships, and job listings.

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. METRANS.com is being updated as a portal for all five METRANS related centers including the newest center Pacific Southwest Region UTC (PSR).

METRANSInfo: 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. We will incorporate new blog contributors from the PSR consortium into the series.

ContainerCasts: These are webcasts focused on topics of interest to the international trade community. Two ContainerCasts were produced and posted during the reporting period. The can be accessed at <https://www.ccpe.csulb.edu/TheManifest/ContainerCast.aspx?pID=13>.

TransCasts: TransCasts are podcasts featuring interviews with METRANS researchers and other distinguished transportation experts. Three were recorded during the reporting period, and are scheduled to be posted in the spring of 2017. Episodes are at <https://www.metrans.org/transcasts>.

Student Podcasts: Student-generated podcasts are produced and posted under the guidance of Associate Director, Deguzman, 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 and Trade Talks: CSULB Associate Director O'Brien's monthly commentary for the Trade and Transportation Perspective column for the Long Beach Business Journal ended in late 2016 due to changes in editorial policies for the paper. Instead, he now hosts a new quarterly television series called Trade Talks produced by CSULB's Advanced Media Production services and distributed through a regional cable network. The episodes are also available via YouTube. The second episode featuring Canadian international trade officials, Patricia Elliott, Consul & Senior Trade Commissioner, and Gavin Nardocchio-Jones Consul for Political & Public Affairs can be viewed here: <https://www.youtube.com/watch?v=D0ouTGwCt0o>

1.3.4 Dissemination

Dissemination is achieved through the events, media, and communication channels described above.

1.3.5 Plans for Next Reporting Period. As of Fall 2017 all events, media and communications activities transition to PSR and will be reported under the PSR grant.

2. Products

2.1 PUBLICATIONS

In this reporting period, the Tier 1 projects resulted in 11 peer-reviewed publications (with 19 under review) and seven presentations (with seven 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) podcasts of METRANS seminars; 2) internship and employment database; 3) Long Beach Business Journal column publications and related podcasts; 4) podcast of Industry Outlook; 5) METRANS news, and 6) 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 (The Auto Club)	Los Angeles	Financial contribution
BNSF Railway	Long Beach	Financial contribution
CITT	CSULB	Home of CSULB METRANS, training and prof programs
Ceres Terminals	Los Angeles	Associate, financial contribution
Caltrans	Sacramento	Match fund sponsor, financial contribution of full required
Economics Dept.	CSULB	Participating faculty, education programs, students
Engineering (COE)	CSULB	Participating faculty, education programs, students
KOA	Monterey	Financial contribution
Foothill Transit	West Covina	Associate, financial contribution
LA Customs Brokers & Freight Forwarders Association	Los Angeles	Financial contribution
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 Los Angeles	Los Angeles	Assoc., financial contribution, internships, scholarships
Sol 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
Watson Land Co.	Carson	Financial contribution
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 in March 2017 and will meet again in November, 2017.

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. 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 Nat’l Transit Institute.

2017 marked CITT’s 20th anniversary as a Center. In recognition of its accomplishments, CITT was awarded the International Achievement Award award by the International Business Association of the Long Beach Chamber of Commerce and was honored by FuturePorts at its annual meeting.

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. The Year 5 Progress Report was submitted to VREF in September 2017, which identifies 41 MF projects, with 28 completed and 13 in progress. During the fifth year of the grant, MF researchers generated 18 refereed publications, 9 research reports, and 4 other publications. They have submitted an additional 13 papers to peer reviewed journals. Research briefs and final research reports are accessible on the METRANS website, along with the Urban Freight Curriculum Guide, which now has over 300 entries. A city logistics introductory textbook is under development. Four MF researchers participated in the 2nd International Sustainable Transport Summit MOBILIZE held in Santiago, Chile from June 28-30, 2017. Seventeen will participate in the October 2017 I-NUF Conference in Long Beach. VREF has formally extended the MF five year grant through December 2018.

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.

Southwest Transportation Workforce Center (SWTWC): METRANS is home to SWTWC, one of five regional centers that form the National Network for the Transportation Workforce (NNTW). 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. During the reporting period, SWTWC was awarded a grant from the Federal Highway Administration for a National Transportation Career Pathways Initiative. SWTWC's partners in the grant include the other four centers in the NNTW.

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, active METRANS UTC research projects fund 52 student positions. Of those hired, there are four undergraduates, 19 masters, and 23 PhD students. Eleven positions were made possible by research projects started in August, and students will be hired to fill these positions in the next reporting period. At CSULB, METRANS UTC research funds 11 research assistants: seven undergraduate students and three master's students, and one doctoral student on research projects being undertaken by CSULB professors. In addition, 12 graduate students and two undergraduate students at CSULB's Center for International Trade and Transportation (CITT) on a variety of METRANS projects including social media, web management, conferences, non-credit training programs, and workforce development-related programs. 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 six student administrative assistants at USC directly supported by METRANS funding, five are members of underrepresented groups, four are both female and a member of an underrepresented group. Of the sixteen research and student assistants at CSULB directly supported by METRANS funding, six are female and thirteen are members of an underrepresented group (CITT: 5 female, 9 underrepresented; COE: 1 female, 4 underrepresented). Of the 52 students supported by METRANS UTC research funds, 45 are from underrepresented groups and 18 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 programs limited to degree granting programs. Eighteen students were awarded scholarships in 2016-2017, for a total of \$45,525.

Opportunities for Research: Student support is an important component of research project selection. At CSULB, 3 faculty and 11 student researchers participate in these projects. In addition, CITT employs one undergraduate on six graduate students who conduct research through SWTWC including research on transportation labor market analysis.

New Educational Materials and Programs and Opportunities for Teaching: We began development of 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 former 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. O'Brien is also a member of the Intermodal Freight Terminal Design Committee. CITT Director of Research Tyler Reeb serves on the TRB Education and Training Committee. 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.