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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, passengers 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 a body of 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 both freight and passengers, system efficiency outcomes are achieved.

1.1.1 Research Program Themes

Our research program is organized around two themes and a set of associated topics. 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

For Year 1 our research program had two parts. The first were pre-selected Launch Projects, listed below.

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

As noted in previous PPPRs, two launch projects were cancelled and one new project was added (1-1b) due to availability of researchers. There are a total of 6 launch projects, two completed and four in progress. Caltrans established new policies for match funding which require approval of every project as a “task order,” adding 3 to 6 months to the contracting process. Caltrans funded projects were delayed to August 2014. Funds from deferred projects were moved into open solicitation research project funds (see Section 1.1.2, Table 2).

Year 1 Launch Project Progress Reports

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)). 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. Tasks 1 through 6 (literature review, data collection, Los Angeles (LA), San Francisco, and San Diego region analysis, comparative analysis) are complete. Task 7 (final report) is in progress. Scope of work was modified to reflect data availability. We could not obtain truck flow data from the San Diego metropolitan area, so estimate models of the relationship between land use and freight flows only for LA and San Francisco. We estimated two sets of models, one using categorical dummy variables as measures of development intensity (employment, and population density), and the other using employment and population characteristics. The models 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. We added Sacramento to our study so that we could conduct qualitative comparisons of the four largest metro areas in California to support the development of a city logistics typology. 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 with economic structure. We use these spatial patterns to show how the general contours of freight activity may be imputed. We expect to complete the project within the next reporting period.

USC 2-1a: Efficiencies in Freight and Passenger Routing and Scheduling (Dessouky, USC) (1/1/2014 – 6/30/2015 (no cost extension)). The final report has been completed and is published on the METRANS website. 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 instance, 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. Thus the look-ahead dynamic routing strategy showed its merits for problems with high level of uncertainty. Overall, our proposed approach could generate routing solutions that could 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 like LA.

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 (no cost extension)). The final report has been completed and is published on the METRANS website. We developed two control strategies for traffic light control that take into account the two different classes of vehicles in areas where the truck volume is relatively high. The two classes are trucks and other vehicles. The other vehicles include light duty and passenger vehicles. Buses and any other type of vehicles have not been considered due to their relatively low volume when compared with trucks in certain areas. 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. Results show that the network traffic performance criteria (reduced traffic delays, number of stops and environmental impact) are improved with the proposed scheme when compared with fixed traffic control signal and optimized traffic light control with no truck priority.

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)). The impact of polycentric metropolitan development patterns on passenger traffic and freight flows is poorly understood. In this research, 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 – a topic almost absent from the literature – and so we are focusing our research on that question and will not examine passenger travel in this research. After searching for appropriate freight traffic data sources we have identified data developed by the Southern California Association of Governments (SCAG) as the best available information on truck traffic flows on road/arterial links in the LA region. During this reporting period, we also analyzed freight flows descriptively and visually, and are now able to identify locations of high freight traffic and high freight traffic density. We are proceeding to assess the characteristics of those locations and the relationship to the spatial location of employment, including employment sub-centers.

CSULB 2-2 Mitigating Urban Freight through Effective Management of Truck Chassis (O'Brien, CSULB) (8/25/2014 - 12/31/2015 (no cost extension)). 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. This project involves five tasks: (1) Review of equipment management literature, (2) Survey of chassis management practices in Southern California, (3) Institutional assessment of Chassis Operations Group, (4) Impacts of changing chassis management practices on regional supply chains, and (5) Final report. Tasks 1 and 2 have been completed. Tasks 3 and 4 are underway. A no cost extension was requested for the project until 12/31/15 to incorporate a new equipment management strategy being tested by the Ports into our study. This will make the analysis as complete as possible and its findings relevant for the broader research community.

CSULB 1-3a Tracking Truck Flows with Programmable Mobile Devices for Drayage Efficiency Analysis (Lam, CSULB) (8/25/2014 - 10/31/2015 (no cost extension)). Inefficient use of drayage trucks results in pollution and congestion. A full measure of the current state of drayage efficiency and future changes as trade volume grows can only be obtained through detailed tracking of drayage activities. Recent emergence of tablet computers provides an ideal platform for the design of an Electronic On-Board Recorder (EOBR) for such tracking, and a prototype device has been developed. This project consists of 8 tasks: 1) Survey the latest programmable mobile devices, compare and evaluate them against the prototype in terms of capability, usability, ease of development, and future enhancement, 2) Produce detailed specifications of the EOBR based on development and field experimentation experience of the prototype as well as feedback from the truck drivers involved in the test runs, 3) Develop software for data logging. 4) Identify and negotiate with truck drivers for the device deployment and data collection, 5) Train drivers for the use of the device and deploy the device to contracted drivers, 6) Enhance the software required for the mapping of the GPS data and display, 7) Develop/enhance the database for housing the collected data, and 8) Collect geo-fencing data of all terminals in the twin ports and distribution locations that the drayage company uses, map collected GPS data and driver input to events, examine and clean up data, develop software tools for accessing the database for data analysis and display and a website for accessing the database. We have completed tasks 1-7, and are now completing data analysis and working on the report.

Year 1 Open Solicitation Research Program

The second part of our Year 1 research program was the open solicitation. About half of the research funding available (USDOT and Caltrans match) was reserved for the open solicitation, issued in March 2014 with proposals due in April 2014. We received 15 valid proposals; 5 were approved for funding. The projects started January 2015. Remaining Year 1 funds were made available for Year 2 research.

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

Year 1 Open Solicitation Project Progress Reports

CSULB 14-06 Development of Micro Wireless Sensor Platforms for Collecting Data of Passenger-Freight Interactions (Mohammad Mozumdar, CSULB) (1/1/2015 - 12/31/2015). We suggest a solution to build smart highways by implanting wireless Micro-Electro-Mechanical System (MEMS) sensors which act like *Neurons* to collect traffic data for vehicle movements. We are exploring available components for Sensor Node design (MEMS magneto-resistive sensors, low-power micro-controller RF transceiver, energy scavenging module, high-capacity small battery) to build a Sensor node prototype. We developed an in-node microprocessor-based classification approach to analyze and determine the types of vehicles passing over a sensor. Our approach for vehicle classification utilizes a decision tree model generated from features extracted from vehicles passing over the sensor. Ideally, using fewer attributes to generate the model allows for the highest computational efficiency. The model can be implemented using nested if-loops in any language on a multitude of microprocessors. In addition, setting an adaptive baseline to negate the effects of background magnetic field allows reuse of the same tree model in multiple environments. The result shows that the vehicle classification system is effective and efficient.

CSULB 14-13 Smart Truck Driver Assistant: A Cost Effective Solution for Real Time Management of Container Delivery to Trucks (Burkhard Englert, CSULB) (1/1/2015 - 12/31/2015). In this project, we obtain accurate truck and port monitoring data at no additional equipment cost. Our system will utilize the rich sensors of ubiquitous smartphones to track all movements of trucks outside and inside terminals. It will allow us to measure truck turn times more accurately by using GPS, network antenna and the inertial sensors of truck drivers' smartphones. We developed a prototype and are now in the process of testing. Our algorithms will analyze collected data to derive real time and detailed models of cargo traffic flow in and around terminals. Our mobile phone application will provide information to drivers as well as to port and terminal authorities, ensuring the use of our application by port stakeholders and allowing us to collect the needed data. This data can be employed to build a comprehensive database of port transportation. We developed and tested a mobile application that allows stakeholders to track truck movements. On the client side, it allows truck drivers to obtain information about their container pick-ups and drop-offs. On the server side, terminals and trucking companies can monitor and track truck movements and turn-around times in real time.

USC 14-09 A Dynamical Framework for Integrated Corridor Management (Ketan Savla, USC) (1/1/2015 - 12/31/2015). We develop dynamic traffic signal control algorithms inspired by proportionally fair (PF) algorithms from communication networks, which are decentralized, and offer advantages in comparison to their counterpart in max pressure (MP) based algorithms, not requiring information about turning ratios and saturation flow capacities. An implication of this feature is that PF controllers are more resilient towards disruptions such as traffic incidents that might cause sudden change in turning ratios. We found through simulations in PTV VISSIM that for a small sub-network in downtown LA, the average travel time under our proposed PF controllers is lower than MP controllers during heavy traffic. We also developed a computational framework that allows computation of variable speed limits, ramp metering and routing suggestions for freeway networks in real time. This work was developed within the framework of dynamic network traffic assignment for continuous time Cell Transmission Models. We are actively developing case studies in the context of Los Angeles using real data, in PTV VISSIM, to facilitate our possible future interactions with LADoT and Caltrans, and to explore transition to practice.

USC 14-11 Vehicle-to-Vehicle Communications in Mixed Passenger – Freight Convoys (Andreas Molisch, USC) (1/1/2015 - 12/31/2015). This project investigates the 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. These scenarios are clearly of great importance for mixed-traffic convoys, yet have not yet been explored or measured. To remedy this, extensive measurement campaigns (e.g. pathloss, dispersion) will be conducted. Then, system performance (e.g. latency, packet arrival rate) in these environments will be simulated, important input for the design of convoy policies, enhanced automated driver assistance, etc. We are working on the following work-packages: 1) Software-defined radio units, for which we have almost finished writing customized codes to fully control behavior during measurements; antennas are being manufactured; 2) Measurement campaigns have been prepared (vehicles that will be used, scenarios to be investigated, measurement set-up, etc.); 3) Physical (PHY) and medium access control (MAC) layers of the IEEE 802.11p standard have been implemented in MATLAB and validated using reference channel models.

USC 14-04 Analysis and Prediction of Spatiotemporal Impact of Traffic Incidents for Better Mobility and Safety in Transportation Systems (Cyrus Shahabi, USC) (1/1/2015 - 12/31/2015). In this period, we focused on two major tasks. First, we addressed the problems of the latent model used in our traffic prediction algorithm. In particular, our algorithms suffered from data sparsity i.e., large number of arterial and highway edges are not equipped with sensors and/or sensors are too far away to analyze the impact. We developed a locally weighted regression technique to estimate the speed of a highway segments (without a sensor) by using nearby sensors (both up- and downstream) in the same direction. We also partitioned the road network into grid cells and developed a spatial and temporal correlation technique that infers the speed of arterial segments in each cell by using the sensors in the corresponding cells. Modifications we implemented improved the prediction accuracy by at least 20%. Second, we developed a novel Graph Matrix Factorization (NMF) technique to learn the latent space from the transportation network, which takes into account the topology and segment attributes. The preliminary results show that this technique can learn traffic congestion in a short time but has problems in identifying immediate changes. To address this problem, we will next investigate incorporating a temporal matrix to our baseline method NMF to jointly infer the spatial and temporal behavior of the congestion in normal conditions and in the presence of sudden changes caused by accidents.

Year 2 Open Solicitation Research Program

Projects were selected by a competitive process. Year 2 RFP was issued Dec. 2014 with proposals due Feb. 2015. The RFP included a general solicitation for projects within Center themes and a list of specific projects (also within the themes) from Caltrans. The RFP is at <http://www.metrans.org/research-projects/metrans-utc>. All tenure track and research faculty at USC and CSULB were eligible to submit proposals; 15 complete proposals were received and 10 were selected for funding. See Table 3 below.

| Table 3: Year 2 Open Solicitation Projects, RFP No. 1 | | |
|--|---|----------------|
| Theme 1 | Understanding Passenger-Freight Interactions | 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> | 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 |

Because relatively few proposals addressed the Caltrans topics, a second Year 2 RFP was issued in March (<http://www.metrans.org/research-projects/metrans-utc>) and included a solicitation for Year 2 projects under NCST. Proposals were due April, 2015. Nine proposals were received and 7 were selected for funding. One will use Tier 1 funding. Start date will be January 1, 2016. See Table 4 below.

| Table 4: Year 2 Open Solicitation Projects, RFP No. 2 | | |
|--|---|----------------|
| 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 |

CSULB 15-01 Investigations of the Effect of Humid Air on NOX & PM Emissions of a CNG Engine (Hamid 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. 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 investigations 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. The modeling is near completion and we are at the initial stage of simulations. The second is experimental investigations of the impact of humid air intake on CNG NOx and PM emissions. For this part of the study, the engine has been secured and is in the process of installation on a portable dynamometer.

CSULB 15-02 Simulation of Liquefaction-Induced Damage of the Port of Long Beach Using the UBC3D-PLM Model (Luis 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. Expansion projects at the Port of Long Beach have been completed by placing hydraulic fill behind rock retention dikes. These man-made loose deposits have shown to be susceptible to liquefaction. Meetings with the senior engineers at the Port were held during this reporting period to define the scope and cooperation of the Port in this research effort. Extensive subsurface exploration information regarding a specific pier within the port were provided to start developing the work. The team processed that information to evaluate the factor of safety against liquefaction based on SPT and CPT data. Preliminary estimates of the liquefaction potential provide factors of safety lower than one. The team obtained also from these meetings with the port a comprehensive seismic ground motion report of the Port of Long Beach that will be used for the earthquake input motion in the proposed analyses. Constitutive parameters for the UBCPLM3D model are being calibrated using the information provided to the research team. This project will contribute to understanding the role of engineering on the resiliency of the Port of Long Beach, vital for the California freight network.

USC 15-03 Development of an Economic Framework to Evaluate Resilience in Recovering from Major Port Disruptions (Dan Wei, USC) (8/15/2015 – 8/14/2016). The objective of this study is to develop an operational 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 will extend and adapt a computable general equilibrium (CGE) model developed by the research team, and apply it to quantify the relative contributions of various resilience options in mitigating potential economic impacts from port disruptions. The U.S. Geological Survey Science Application for Risk Reduction (SAFRR) Tsunami Scenario that impacts the major seaports along the California coast will be used as a case study to illustrate how we apply the economic resilience framework to assess the applicability and effectiveness of various economic resilience tactics. We will focus our case analysis on three major ports in California: Port of Los Angeles, Port of Long Beach, and Port of Oakland. The research team is currently working on Task 1 (Literature Review) and also has started collecting trade data that will be used in Task 4 (the Case Study). We will next start working on Task 2 (Resilience Framework Development) and Task 3 (Extension and Adaptation of the USCGE Model).

USC 15-04 Integration of Passenger and Freight Rail Scheduling (Maged 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 while traveling on the main corridors. Typically, passenger train and freight train scheduling are performed separately. Passenger train schedules are usually based on fixed timetables whereas with freight train scheduling there is more flexibility in

setting their departure times. We will investigate the impact and resulting 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. In this area, the railway trackage is around 390 miles with about 358 trains per peak day (195 freight trains and 163 passenger trains). Amtrak and Metrolink trains travel through this corridor. We have started task 1 of the project (update the train data sets and literature review).

USC 15-08 Application of a Regional Multi-Modal Transportation System Performance Monitoring Framework (Genevieve Giuliano, USC) (8/15/2015 – 8/14/2016). The purpose of this research is to examine 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 have started working on tasks 1 and 2. We are downloading (from the Archived Data Management System) highway and arterial traffic data, and performing data quality checks. We are also collecting and analyzing attributes of various road network datasets.

CSULB 15-10 Route Choice Characteristics of Owner-Operated Trucks in Southern California Freeways (Jin-Lee Kim, CSULB) (8/15/2015 – 8/14/2016). This project develops 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 on stated preference survey methods; 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 of the survey instrument. Task 1 is currently underway.

USC 15-12 Optimum Routing of Freight in Urban Environments under Normal Operations and Disruptions using a Co-simulation Optimization Control (Petros Ioannou, USC) (8/15/2015 – 8/14/2016). In this project we plan to design, analyze and evaluate a co-simulation optimization control approach for optimizing freight transportation in an urban environment under normal operations and disruptions. In particular we plan to develop real-time simulation models with on line reconfiguration capabilities for travel time and other link costs predictions, combine the simulation models with optimization and dynamical control techniques for freight routing under normal operations and disruptions, demonstrate the approach using an example from the Los Angeles/Long Beach Port area.

USC 15-13 Development Affordable Housing Guidelines near Rail Transit in Los Angeles (Raphael Bostic, USC) (8/15/2015 – 8/14/2016). Los Angeles County has over 100 rail transit stations open or scheduled to open in the next decade. Two questions are central to sound land use planning near stations, but have not been effectively analyzed together. First, will development near rail stations support Los Angeles' goals for more affordable housing? Second, as residents move into transit-oriented developments, will those new residents use transit more and drive less, supporting California's greenhouse gas (GHG) emission reduction goals? We will compare the effect of different station-area development typologies on both housing affordability and GHG emissions. Our objective is to inform planning and housing policy in the City of Los Angeles and in the broader LA metropolitan area. First, we have been working to create building typologies that will be the basis for our normative assessment of various development strategies around transit stations. They vary in the amount of housing provided, the density of that housing, the affordability of that housing, and the mix of land uses in operation. Second, we have been building models that will allow us to determine the impact of different changes in development patterns on housing affordability and greenhouse gas emissions. We will do this by detailing the transition paths that would occur if development were to shift from one typology to another. After

specifying the level of affordability associated with a given transition, each transition path implies in-migration and out-migration of families at different income levels. These movements bring with them changes in VMT, which allows for a summary measure of the VMT and, by extension, GHG changes induced by pursuing specific development strategies. With these two pieces of information, practitioners can simultaneously see the affordable housing and greenhouse gas implications of given strategies, which should inform future deliberations and result in more sophisticated and evidence-based decision-making.

USC 15-14 Quantifying the Impact of Next-Generation Modes of Delivery (John Gunnar 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. Thanks to recent innovations in telecommunications and location-based services, there is currently an unprecedented expansion of last-mile delivery services that transport products to households within a short time frame, often within the span of a few hours. The net impact of the introduction 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, thereby 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 two tasks of our proposal, namely a literature review and an analysis of multi-stop trips. We are completing task 3, applying our analysis of multi-stop trips to study the amount of adoption of delivery services necessary in order for social benefits to be realized.

USC 15-15 The Decline in Inter- and Intra-Urban Mobility and its Impact on Passenger Travel (Gary Painter, USC) (8/15/2015 – 8/14/2016). This project consists of three parts. First, analyze the characteristics and implications of declining U.S. migration trends. Second, conduct empirical analyses to determine how the current trend affects urban passenger travel demand. Finally, 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. While there has been an increase in the immigrant populations over the past 4 decades, this population is now much more mature and has been in the U.S. longer than it was in the 1980s. We analyze the most recent changes, and document the determinants, magnitudes, and characteristics of the decline in inter- and intra-urban mobility. We are currently working on 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 are developing the methodology, reviewing the literature, and considering data availability and accuracy. We will begin with a longitudinal analysis of the determinants of transit ridership across U.S. 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 (Genevieve 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. This project has not yet started.

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:

- 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.
- J. Carlsson, "Household-Level Economies of Scale in Transportation," under minor revision with *Operations Research*.
- M. Dessouky, and H. Zou, "A Look-Ahead Routing Strategy for Solving the Dynamic Vehicle Routing Problem."
- B. Englert, "A Smartphone-Based Truck Monitoring System for the Ports of Los Angeles and Long Beach."
- G. Giuliano, S. Kang, and J. Yuan, "Using Proxies to Describe the Metropolitan Freight Landscape," submitted to *Urban Studies*.
- M. Mozumdar, "Machine Learning Based in Node Vehicle Classification Method for Smart Roadways."
- 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*.
- K. Savla, "Throughput Optimality of Proportionally Fair Traffic Signal Control Policies under General Phase Architectures," tentatively planning submission for *SIAM Journal on Control and Optimization*.
- K. Savla, "Distributed Algorithms for the Dynamic Network Traffic Assignment," tentatively planning submission for *IEEE Transactions on Control of Networked Systems*.
- Y. Zhao, F. Vital, P. Ioannou and T. Rajabioun, "A Traffic Light Priority System for Trucks and Its Impact on Traffic Flows" to be submitted to *IEEE Transactions on Intelligent Transportation Systems*.

The following were recently submitted for conference presentation.

- T. O'Brien, "Trucking Regulation as a Critical Supply Chain Asset in Port Complexes," submitted for presentation at the 14th Conference on World Transport Research in Shanghai, China, July 2016.
- T. O'Brien, "Trucking Regulation as a Critical Supply Chain Asset in Port Complexes," proposal submitted for presentation at the 2015 International Urban Freight Conference, Long Beach, CA, October 2015.
- K. Savla, "Distributed Optimal Equilibrium Selection for Traffic Flow over Networks," submitted for presentation at the IEEE Conference on Decision and Control at Osaka, Japan, December 2015.
- K. Savla, "Entropy-like Lyapunov Functions for the Stability Analysis of Adaptive Traffic Signal Control," submitted for presentation at the IEEE Conference on Decision and Control at Osaka, Japan, December 2015.
- Y. Zhao, F. Vital, P. Ioannou and T. Rajabioun, "Evaluation of Traffic Light Priority for Trucks on Traffic flow," submitted for presentation at the 2015 International Urban Freight Conference, Long Beach, CA, October 2015.

During this reporting period, the following were presented:

- A. Bento, "Closing the Carbon Price Gap: Public Finance and Climate Policy", Invited Speaker, International Conference organized by the Mercator Research Institute on Global Commons and Climate Change. Berlin, May 2014
- J. Carlsson, "Household-Level Economies of Scale in Transportation," 2015 TSO Workshop, USC, Los Angeles, CA, May 2015.
- G. Giuliano, "Optimization in Real Transportation Systems," 2015 TSO Workshop, USC, Los Angeles, CA, May 2015
- G. Giuliano, "The Metropolitan Freight Landscape: Concepts and Some Preliminary Results," Second Interdisciplinary Conference on Production, Logistics and Traffic, Dortmund, Germany, June 2015.
- G. Giuliano, "Transportation and Land Use: What Do We Know About Freight?" International Association of China Planning Conference, Chongqing, China, June 2015.
- P. Ioannou, "Adaptive Truck Signal Priority System," 28th Southern California Nonlinear Control Workshop, UCLA, Los Angeles, CA, May 2015.

- P. Ioannou, “Load Balancing Using a Co-Simulation/Optimization/Control Approach,” 2015 TSO Workshop, Los Angeles, CA, May 2015
- P. Ioannou, “Modeling Complexity and Control Issues in Transportation Systems,” Institute for Pure and Applied Mathematics, UCLA, Los Angeles, CA, September 2015.
- K. Savla, “Stability Analysis and Control Synthesis for Dynamical Traffic Systems: from Microscopic to Macroscopic,” 2015 TSO Workshop, USC, Los Angeles, CA, May 2015.
- R. Wang, O. Renaudin, R.M. Barnes, and A.F. Molisch, “Efficiency Improvement for Path Detection and Tracking Algorithm in a Time-Varying Channel,” IEEE 82nd Vehicular Technology Conference, Boston, MA, September 2015, pp. 1 – 5.

1.1.4 Plans for Next Reporting Period

Plans are to: 1) Complete the Year 1 launch projects; 2) Continue work on the Year 2 projects; 3) Start work on the final project from Year 2; and 4) Continue dissemination of research results via our website, other publications, papers, conference presentations, and via 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 passenger 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 dissertation research 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 for 2014-15 without offering separate assistantships. These funds were therefore shifted into the research project funds.

New Graduate Courses: Two new PPD courses were introduced at USC fall 2015 and 4 new SCM courses were introduced at CSULB fall 2015 as part of their new Master of Science in Supply Chain Management Degree (MSCM). These courses are *PPD 599, Transportation and City Design; PPD 599, Urban Mass Transit; SCM 500, Research Methods for Supply Chain Management; SCM 520, Business Economics; SCM 611, Operations Planning and Analysis SCM 657, Seminar in Supply Chain Leadership.*

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 (RDS) for engineering drivers and software for development of online interactive exercises and educational modules necessary for the new undergraduate minor in transportation. The platform is expected to be functional in February 2016.

Degree Related Internships: Internships are part of the Masters of Planning and of Public Policy at USC. At both campuses, METRANS helps to facilitate student placement in transportation related internships.

1.2.2 Facilitating Connections between Students and Employers

Professional Development: We 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 Deguzman serves on the Resume Book Committee and conducts outreach for WTS throughout the greater LA region. We provided assistance to three USC undergraduate students (one female and two from underrepresented minority groups) who were selected to attend the California Transportation Foundation (CTF) Annual Education Symposium, a highly selective, two day symposium designed to provide professional development and real world transportation problem solving experience to high performing college juniors and seniors studying in a transportation related field. 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: This program guides students who plan to pursue a nonacademic career in transportation to make informed career decisions and to develop into well-rounded professionals. Mentors broaden the students' educational experience through personal interaction, an opportunity often missing in formal education. During the reporting period, the mentor program completed its fourth and entered its fifth year. Applications are received on a rolling basis, and based on the number of applications received in the first month of the fall semester we expect to continue our year over year growth. Of the 21 mentees completing year four, 15 are members of minority groups, 8 are female, 5 are both female and a minority, and 1 is both female and a member of an underrepresented group. Of the 18 applications received in the first month of this new academic year, 9 are female, 14 are members of minority groups of which 4 are members of underrepresented minority groups, and 2 are both female and a member of an underrepresented group.

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. Two were held during this reporting period and five are planned for the next reporting period. The lower number this period is due to the summer break.

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, 33 USC students were successfully placed in transportation internships, and 7 secured employment as a result. Providers include LA Metro, the LA DOT, the Port of Los Angeles, the Port of Long Beach, the LA County Bicycle Coalition, Southern California Association of Governments, the South Coast Air Quality Management District, Fehr and Peers, Iteris, the City of San Diego, and Foothill 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, a partner organization to METRANS at CSULB) has also established a job and internship post, at the CITT Manifest website: <http://www.ccpe.csulb.edu/TheManifest/calendar.aspx>

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 increasingly complex urban and suburban planning environments.

Certificate in Transportation Systems: This is an interdisciplinary program administered by the USC Department of Civil Engineering, open to graduate students campus wide, combining engineering with policy, planning, and project management. During the reporting period, 5 were enrolled, and 5 graduated.

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 invited cosponsors such as student, academic, and professional groups. Many are recorded and made available through social media. Seminars are well attended, with an average attendance of over 60. See below.

Table 5: METRANS Seminar Series held during the reporting period

| Date | Speaker(s) | Title |
|-----------|---|--|
| 4/8/2015 | Sandip Chakrabarti, Eun Jin Shin USC PhD Candidates | Association of Collegiate Schools of Planning (ACSP) Conference Topics |
| 9/16/2015 | Susan Handy, Director, National Center for Sustainable Transportation, UC Davis Professor | The Future of Travel Demand ^a |
| 9/30/2015 | Yuting Hou, EunJin Shin, Xize Wang USC Price School PhD Candidates | Association of Collegiate Schools of Planning (ACSP) Conference Topics |

^a Jointly sponsored by the Nat'l Center for Sustainable Transportation

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 the USC McNair/Gateway Scholars program, WTS LA, WTS OC, USC Student Chapter of the Institute for Transportation Engineers (ITE), USC Student Chapter of the American Planning Association (APA), USC Price Sol Global (graduate level students of planning policy), USC Price Women Leading Policy, Planning, and Development (WLPPD), Young Professionals in Transportation (YPT), USC Price Partnership for an Equitable Los Angeles (PELA), USC Price Students of 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), USC Price Latino Student Association (PLSA) and the USC Price Graduate Policy and Administration Community (GPAC). METRANS also provides 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 on our various media.

Field Trips and Site Visits: During the reporting period, students toured an active duty U.S. NAVY Vessel, on Saturday, August 8, 2015. The trip consisted of a full day on the LA Waterfront as they visited a Navy ship, USMC equipment displays, the Tall Ships, and historic Ft. MacArthur vehicles in the Downtown Harbor. As this reporting period is mainly during spring finals, summer, and the first month of fall, there are fewer field trips than in the prior reporting period. Field trips for the remainder of the fall semester include visits to Los Angeles Metropolitan Transportation Authority (LA Metro) and to Foothill Transit.

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 College of Engineering. The program starts with an introductory class offered online which facilitates access for qualified senior high school students.

USC Price Research Fairs: We regularly present information regarding transportation education, research, careers, employment and internships opportunities, and transportation related resources at research fairs held for students admitted to and considering enrolling at Price. During this reporting period, METRANS faculty, staff and students participated in the Price Merit Scholars Research Fair.

Career Fairs and Career Nights: We also host and participate in events designed to match students with potential careers and employers. During this reporting period, METRANS staff and students participated in the Price School Career Fair, and the WTS LA and WTS OC Career Day events.

1.2.7 Dissemination

Dissemination is accomplished through student research assistantships, degree and non-degree courses and certificate programs, information and assistance regarding internships, employment opportunities, and professional development, seminars and educational series, METRANS website, student research opportunities, support and outreach to student groups, research fair presentations, and student engagement in the mentor program and internships. We also use the METRANS Facebook page, LinkedIn account and Twitter account to disseminate information and our podcast series to highlight Center programs. We average over four posts a day on the Facebook page and two tweets per day via Twitter. Between the start of the period and its completion, the number of METRANS Twitter followers increased by 27, from 173 to 200. The METRANS LinkedIn page has 96 members, and much of the information on METRANS related programs is shared via the CSULB CITT LinkedIn site, which currently has 1,111 members.

1.2.8 Plans for Next Reporting Period

To 1) Continue our professional development, student recruitment and support, and educational enrichment programs; 2) Continue develop of the Metropolitan Transportation Management Certificate with LA Metro, 3) Continue the seminar series; 4) continue the Lunch with a Practitioner series, 4) Participate in the Price School Admitted Students Research Fair and the Price School Merit Scholars

Research Fair 5) Complete technology tests of the Remote Desktop Service that will allow us to launch the online platform serving both the VTA and the new CSULB COE undergraduate degree in transportation engineering and 6) Select and sponsor the METRANS 2016 student of the year.

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 provides a forum for sharing emerging, multi-disciplinary research on all aspects of freight in metropolitan areas. During the reporting period, we planned the 6th METRANS I-NUF, to be held October 21-23, 2015 at Westin Long Beach. More than 120 presentation abstracts were received for this year's conference. Special sessions and/or committee meetings will be sponsored by the TRB Urban Freight Committee, Intermodal Freight Transport Committee, Young Members Council and by the Freight Committee of the American Society of Civil Engineers (ASCE).

1.3.2 Outreach Events

We held our third Industry Outlook event, "The Future Transportation Professional," on May 20 at USC, a panel discussion of representatives from industry and academia.. Moderated by METRANS Associate Director, O'Brien, the panel discussed the skills that future professionals in the transportation field require to be successful. See <https://www.youtube.com/watch?v=TFPMwHAQ18Q>. The event was attended by more than 75 people. The next Industry Outlook is planned for early 2016.

Transportation Optimization Workshop: In partnership with the USC Epstein Department of Industrial and Systems Engineering, METRANS held a statewide workshop on optimization methods and applications on May 8, 2015. The workshop brought together 10 transportation optimization scholars from throughout California and promoted research collaborations to an audience of 48 people. Four METRANS faculty members gave presentations.

Working and Living in a Port City Series: Introducing local decision makers and community residents to maritime 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. During the reporting period, CITT conducted outreach for the next set of workshops, to be held in November 2015.

1.3.3 Media and Communications

Scholarly Venues: METRANS is committed to conducting 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. As part of I-NUF 2015, we are soliciting papers for submission to two special journal issues, one in urban planning and one in logistics.

The Manifest: An Industry Event Calendar: The Manifest 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 Manifest. 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. These briefs are widely circulated through both traditional and social media. During the reporting period, two research briefs were produced, "Train Scheduling and Routing under Dynamic Headway Control" (Dessouky) and "Adaptive Truck Priority Signal System" (Ioannou).

METRANS News: METRANS News is a tri-annual newsletter that features the research, education and outreach activities of METRANS, published in both print and online. The most recent issue was published in the summer 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 that is posted on the METRANS website. It is also posted on the TRB e-newsletter and is also distributed at conferences, events, and meetings.

METRANS Website and Social Media: New content continues to be added to the website, and news articles and opportunities are generated and posted on a weekly basis. The Tier 1 UTC may be accessed at www.metrans.org/metrans-utc. We are also active on Facebook, Twitter, and LinkedIn.

METRANSInfo: This is a queryable database under development. It will include definitions, basic information on urban transportation systems and data. A research assistant will coordinate development.

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

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*, highlighting important issues in goods movement and international trade and featuring CITT activities and research findings. Six articles were produced during this reporting period and can be found at <http://www.ccpe.csulb.edu/CITT/IndustryArticles.aspx>.

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 the following: 1) Publish completed METRANS research reports and briefs to the website; 2) Coordinate and host INUF; 3) Publish news including bi-monthly updates; 4) Enhance and expand the website; 5) Continue social media programs and grow subscriber database for LinkedIn and followers of Twitter; 6) Offer the series on Working and Living in a Port City and 7) Hold our Fourth Industry Outlook event in early 2016.

2. Products

2.1 PUBLICATIONS

The Tier 1 projects have not yet resulted in peer reviewed publications. With the year 1 projects approaching completion, some papers are under review, and others are in preparation for submission. In addition, results have been presented at several conferences. See Section 1.1.3.

2.2 WEBSITES

The website may be accessed 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 during the reporting period.

2.6 OTHER PRODUCTS

1) Freight landscape database created under project 1-1b and jointly with MF; 2) Podcasts of METRANS seminars; 3) Internship and employment opportunities database; 4) O'Brien 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 are those organizations that directly contribute to the work of the Center through financial or other support, or that participate directly in the research. Organizations that participate in Center activities, provide advisement, or generally support the center are collaborating organizations.

3.1 PARTICIPANTS

At USC, the Price School of Public Policy and the Viterbi School of Engineering are the main partners. At CSULB, participants are CITT, the School of Engineering, the Department of Economics, and the School of Business. METTRANS is a multi-disciplinary research center, and researchers routinely collaborate across department and school boundaries. Caltrans is the major funding partner, providing the entire required match for the Center. Additional financial support is provided by METTRANS Associates, and by individual corporate contributions to scholarships and education programs (see table below).

| Name | Location | Contribution |
|-------------------------------|-----------------|--|
| APM Terminals | Long Beach | Associate, financial contribution |
| CITT | CSULB | Home of CSULB METTRANS, participating faculty, training and professional education programs, students; METTRANS 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 |
| ILWU | Los Angeles | Associate, financial contribution |
| Majestic Realty | Industry | Associate, financial contribution |
| Metro | Los Angeles | Associate, financial contribution, internships, research funding |
| Port of Long Beach | Long Beach | Associate, financial contribution, internships, student scholarships |
| Port of Los Angeles | Los Angeles | Associate, financial contribution, internships, student scholarships |
| Price School of Public Policy | USC | Home of Center, faculty, education programs, students; financial contribution for administration; indirect cost share; offices, labs |
| SCAG | Los Angeles | Associate, financial contribution, internships, data sharing |
| Viterbi School of Engineering | USC | Participating faculty, education programs, students; indirect cost and tuition cost share, METTRANS labs |

3.2 COLLABORATING ORGANIZATIONS

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

3.2.1 Advisory Organizations

METTRANS 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 METTRANS 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 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 METTRANS. CITT Executive Director, Thomas O'Brien, serves as a METTRANS

Associate Director. The CITT has several noteworthy educational programs which are 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 in 2016. CITT has also developed *Principles of Supply Chain Management*, a 36-hour (two-week) class on Principles of Supply Chain Management 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. Two separate sessions were offered during the reporting period. A third is scheduled for the fall of 2015. CITT is developing 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 informal relationships with industry and government. SCAG provides regional planning and transportation modeling data. LA Metro funds a major research project to develop a data archive from real-time transportation system monitoring data and develop applications for planning and system management. Several trade organizations offer scholarships and other assistance, including the Los Angeles Transportation Club (LATC), Harbor Transportation Club (HTC), Harbor Association for Industry and Commerce (HAIC) and Council of Supply Chain Management Professionals (CSMCP). The HAIC and LATC 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 9 MF research projects have been completed by the partners and 19 are continuing. We are midway through the 5 year contract with VREF and 10 new projects are being launched during the second half of Year 3, 7 lead by LA and 3 by Paris. Research briefs and final research reports are posted on the MF website. During this reporting period METRANS faculty and VREF partners met and participated in the Korea Logistics Society 2015 Spring Conference: Logistics Innovation Strategy for New Commerce Era, Seoul Korea (May 2015); 9th International Conference on City Logistics, Tenerife, Spain (June 2015); 9th IACP Conference: Smart Growth and Sustainable Development, Chongqing, China (June 2015); 2nd Interdisciplinary Conference on Production, Logistics and Traffic, Dortmund, Germany (July 2015); Asilomar 2015: Transportation and Energy Policy in a Volatile World, Pacific Grove, California (August 2015); SUFS webinar, *Cargo Cycles for Urban Freight: North American Experience*, (August 2015).

A new online graduate course, *Urban Freight and City Logistics*, was taught spring 2015 at CCNY and USC. It is being refined and will be taught again before making the curriculum available to other universities. Jean-Paul Rodrigue of Hofstra University taught a graduate course, *Hinterland Transport and Logistics* at the Chongqing University (China), Joint Institute of Transport and Logistics, (May 2015). O'Brien continues to develop *Urban Freight Best Practices* with MF partners. The MF Urban Freight Curriculum Guide is now available on the website, and the curriculum database has 362 entries.

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. All five launch projects have been started: Reducing Truck Emissions and Improving Truck Fuel Economy via ITS Technologies, Petros Ioannou (PI); Routing Strategies for Efficient Deployment of Alternative Fuel Vehicles for Freight Delivery, Maged Dessouky (PI); Impacts of Legislative Mandates on Transportation Workforce Capacity, Thomas O'Brien (PI); Spatial Dynamics of the Logistics Industry and Implications for Freight Flows, Genevieve Giuliano (PI); and Urban Spatial Structure and GHG Emissions, Marlon Boarnet (PI). A second year open solicitation for NCST projects was included in our second Year 2 RFP. See section 1.1.2 for details.

Southwest Transportation Workforce Center (SWTWC): METRANS is now home SWTWC, one of five regional centers that form the National Network for the Transportation Workforce. Each is dedicated to providing a more strategic and efficient approach to transportation workforce development. FHWA funded the launch of the five centers to build strategic partnerships and engage regional and national stakeholders to advance the goal to develop a skilled and career-ready transportation workforce. O'Brien serves as Director of SWTWC, which is based in the METRANS CSULB offices and includes the following partner institutions: USC 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

Impacts tend to be the result of a cumulative body of work, rather than specific projects or programs. The UTC is part of a larger effort of research, education and outreach. We provide a summary below.

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: As referenced in our performance indicators, at USC, METRANS UTC research funds 3 undergraduate students, 7 master's students, and 18 PhD students. Six master's students work on outreach activities. At CSULB, METRANS UTC research funds 6 undergraduate students and 14 master's students. Two master's students and 2 undergraduate students work on METRANSInfo and social media.

We provide financial and administrative support to allow students to participate in transportation related conferences and competitions as mentioned in Sections 1.2 and 1.3.

Support for Underrepresented Groups: METRANS is committed to promoting diversity, in particular of underrepresented groups. Of the thirteen student administrative assistants directly supported by METRANS funding, two are members of an underrepresented group and six are female. Of the fourteen 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: During the reporting period, we developed and launched the pilot for six new transportation courses and implemented the Long Beach Unified School District Teacher Training course. We have begun testing modules of the undergraduate minor in transportation. There are several additional courses and programs under development, including the Virtual Academy and transportation courses for the USC Executive Master of Leadership Development program. These programs offer new teaching opportunities for more than 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 and the Manifest. New resources include the internship and employment databases. METRANS continues to develop the METRANS InfoShop. At USC, METRANS research activities moved to the new Price Research Center in May 2015. Research facilities include staff offices, high capacity computing, spatial analysis laboratory, secure data servers, and a variety of statistical software.

4.4 TECHNOLOGY TRANSFER

Technology transfer is taking place via the reports, research briefs, papers, and conference presentations based on Tier 1 research.

4.5 SOCIETY BEYOND SCIENCE AND TECHNOLOGY

Our impact takes place through our faculty and researchers. Our faculty serve as 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, as well as on specific policies, such as the proposed Designated Highway Primary Freight Network. Giuliano consulted on state legislation; California AB 2008 promotes dedicated loading space for new developments within transit villages. 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 the Southwest Transportation Workforce Center (SWTWC) and through the CUTC Workforce Development Committee. Giuliano and O'Brien are members of the California freight efficiency group, which is developing recommendations for a statewide freight action plan. Boarnet is in regular communication with transportation policy makers. He presented the results of his research to two policy committees of SCAG, and he has partnered to develop policy briefs that inform the implementation of California's greenhouse gas emission regulatory framework.

5. Changes

There are no changes in the scope or objectives of this grant. All but one of the Year 2 projects were awarded May 2015. The final Year 2 project was awarded August 2015. The three DOT-funded projects began in July 2015. All but one of the Caltrans-funded projects began in August 2015. The last Year 2 Caltrans-funded project will begin January 2016. Education and outreach projects are on schedule.

6. Special Reporting Requirements

No special reporting requirements. Nothing to report.