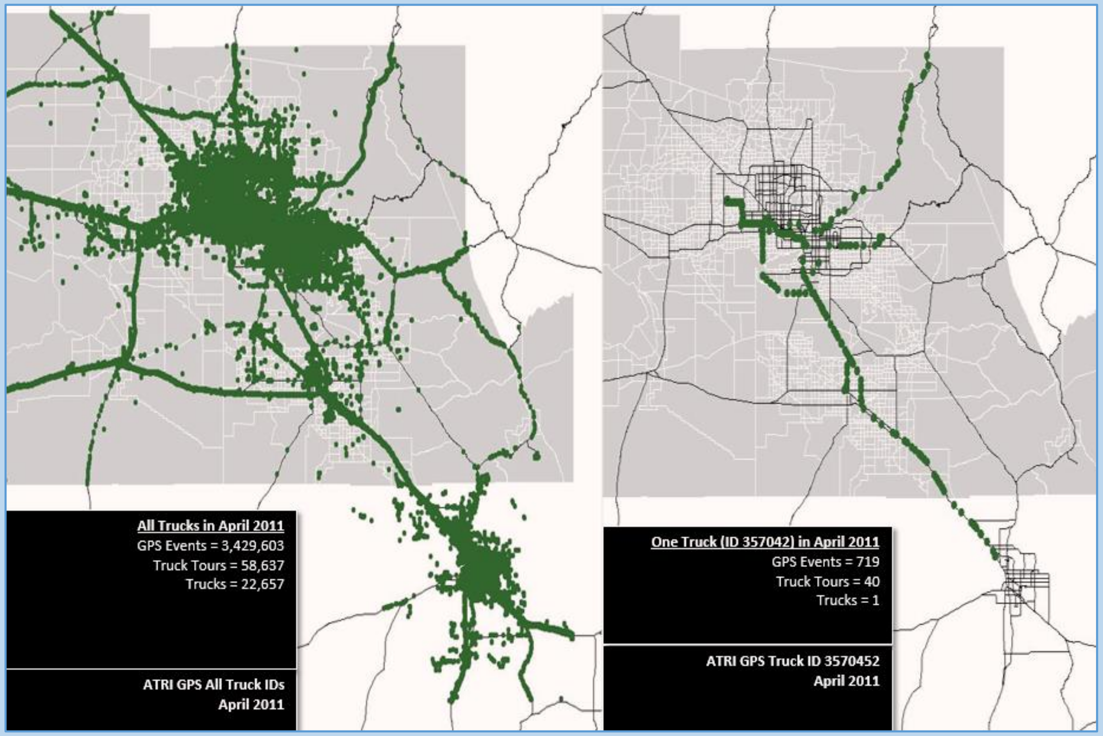
Arizona Freight Demand Modeling

CASE STUDY

Developing multimodal behavioral freight models to estimate freight demand in Arizona's urban areas.

Freight Challenges	Congestion, Land Use
Data Sources Used	Administrative Records, GPS/GNSS
Analytical Approaches	Speed, Location



Tour-Based Truck Travel Demand Model

Source: Kuppam, A., et al. "Development of a tour-based truck travel demand model using truck GPS data", Presented at the 2014 TRB 93th Annual Meeting

WHAT ARE THE FREIGHT CHALLENGES?

Transportation planning must account for the growth in freight traffic and its contribution to road congestion in urban areas. It is also important to integrate land use planning in freight demand models to ensure that transportation conflicts between adjacent zones are kept to a minimum. For example, placing residential property adjacent to existing industrial zones, or vice versa can impede the efficient movement of freight and result in a poor quality of life for local residents. In 2014, the Maricopa Association of Governments (MAG) identified a need for the development of a regional freight forecasting model to overcome the challenges in freight modeling for future demand. Obtaining access to innovative and reliable data sources was also a challenge for MAG to support good planning.

WHAT WAS THE GOAL OF THE PROJECT?

MAG, the Arizona Department of Transportation and the Pima Association of Governments partnered to develop a megaregional freight forecasting model. The goal of this model was to integrate multiple freight data sources to improve the accuracy of truck movements in the regional and statewide models, identify freight-relevant infrastructure improvements, and provide more accurate traffic forecasting to support economic development.

WHAT DATA SOURCES WERE USED?

The megaregional model consisted of multiple sub-models, and each sub-model used different datasets: (1) Firm Synthesis Model: this sub-model simulated operations of the region's firms based on industry type, size, and location. National Establishment Time-Series (NETS) data was used to obtain information on the creation, growth, movement, and closure of firms in the region, (2) Supply Chain Model: this sub-model uses the output of the Firm Synthesis above, publicly-available employment and commodity price data, and IMPLAN tables of input and output commodities of each industry, and (3)Truck Tour Model: this tour-based model uses ATRI's heavy truck GPS data, Streetlight's light and medium truck trip data, and two types of administrative records: TAZ and land use shapefiles, and commodity flow origin-destination information from IHS's Transearch database, and the Freight Analysis Framework. The Transearch data is also used to assign specific commodity flow tonnages to specific sections of the region's transportation network.

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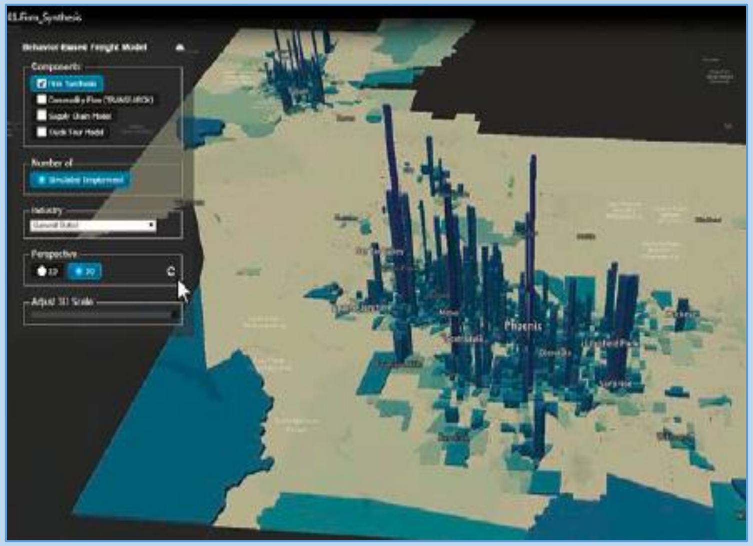

Economic Impact Visualization

Source: Kuppam, A., et al. "Development of a tour-based truck travel demand model using truck GPS data", Presented at the 2014 TRB 93th Annual Meeting

WHAT ANALYTICAL APPROACHES WERE APPLIED?

Analytical approaches varied from sub-model to sub-model, but a common theme throughout the model's development was the fusion of different data sources and model outputs to provide greater insight into freight-relevant phenomena. Summaries of each sub-model's development are (1) Firm Synthesis Model: a series of econometric models use the NETS data to simulate the possible creation, movement, and dissolution of firms in the region. Simulated results are validated by comparison to existing demographic trend and employment data, and both real and simulated events and firms can then be used as inputs for the supply chain model. (2) Supply Chain Model: in this model, firms are considered as individual decision making agents, and the freight market is simulated based on each firm's behavior.

The model also uses the commodity price and source data listed as inputs to a set of models that can produce simulated results of a firms' choice of suppliers, mode of transportation, and size of shipment. The resulting commodity flow estimates can then be integrated into the truck tour model. 3) Truck Tour Model: using data of truck traffic volumes and information (on commodity origins and destinations, this model creates "chains" of truck trips by industry sector and truck type (heavy, medium, or light). The resulting tour-based model can then use land use information and truck GPS track information to generate estimates of the number of stops on each truck tour, as well as stopping locations, purpose, and time of day. These longer tours can also be "unchained" to reveal estimated individual legs of trips.

WHAT WERE THE RESULTS?

The resulting mega-regional freight model covers portions of five counties located within the Phoenix and Tucson Metropolitan areas, including all of the major freight corridors in the state of Arizona. This multi-agency planning approach not only reduced the overall time and cost compared to individual agency models but also provided MAG and PAG with an insight into the scope of freight activity between the two regions. MAG and PAG also incorporated the resulting freight model into their separate travel demand models for validation and comparison with collected vehicle classification counts. The ultimate output of this new generation of megaregional freight model are the internal truck tours by type (heavy, medium, or light). As the ATRI's GPS data only includes heavy-duty truck trips, combining it with Streetlight's light- and medium-duty truck data helped the planners to achieve such level of detail in truck tour simulation. The fact that the final model is based on explanatory variables for different industries, makes it easier for all freight stakeholders to understand the model and provide supporting data and feedback.

HOW WERE THE RESULTS VISUALIZED OR COMMUNICATED?

This project was published in form of a comprehensive report including tools to forecast freight demand throughout the state. The high level of accuracy in data integration necessitated powerful visualization in the model to facilitated decision making, quality control, and big data analysis. The resulting visualization of freight model outputs enhance the use of freight demand forecasting tools for public sector and improves data communication between public and private sector.

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