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ANALYSIS OF FREIGHT MOVEMENT BETWEEN MAQUILADORA INDUSTRY AND PORTS OF ENTRY

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Manufacturing Industry (Maquiladoras)

- The City of El Paso, Texas together with Ciudad Juarez, Chihuahua comprise the largest metropolitan area on the United States - Mexico border. POP. 2,043,514 million
- The El Paso/Ciudad Juarez borderplex economy depends highly on the trade between both cities
- Maquiladora industry has an important role in the economy of the borderplex

Locations of El Paso, Texas and Ciudad Juarez, México
Source: http://www.learner.org/workshops/geography/wkp1map2.html

- Maquiladora industry: manufacturing twin plants
- U.S side factory ship raw material and equipment to Mexico and Mexican side factory (Maquiladora) ship goods produced to El Paso
- A crucial element in its process is reliable transportation of goods

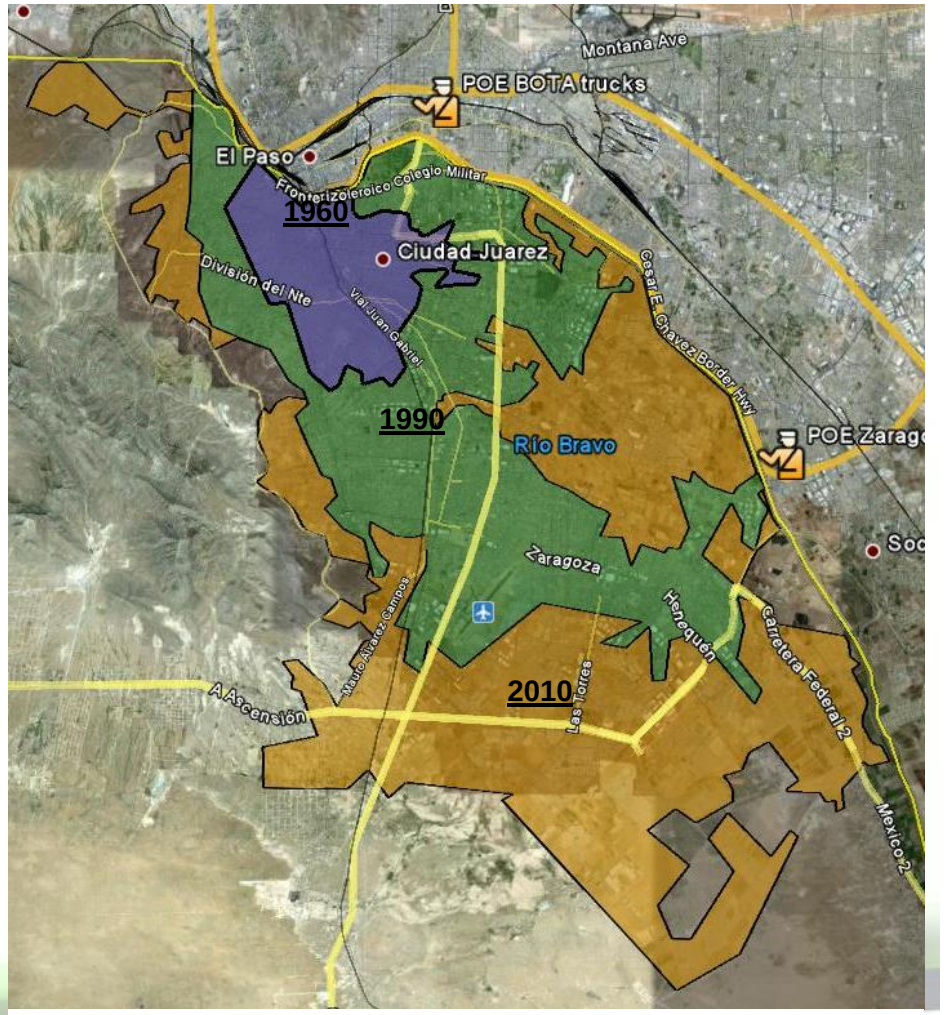
Manufacturing Industry (Maquiladoras)

- 350 Maquiladoras (manufacturing plants)
- 29 Industrial Parks
- Borderplex is 7th largest manufacturing center in U.S. (207,641 persons employed)*
- El Paso is ranked 6th in truck crossing to U.S. (758,856 trucks)*
- $71 Billion in trade crossed the border between El Paso and Ciudad Juarez in 2010 (Import: $41.9 Billion, Export: $29.2 Billion)**
- 18% trade of all trade between U.S. and Mexico**

* Source: El Paso Regional Economic Development Corporation
* * Source: Research and Innovative Technology Administration Bureau of Transportation statistics, U.S Department of Transportation, April 2011
*** Source: Texas Center for Border Economic and Enterprise

Mobility issues in Ciudad Juarez

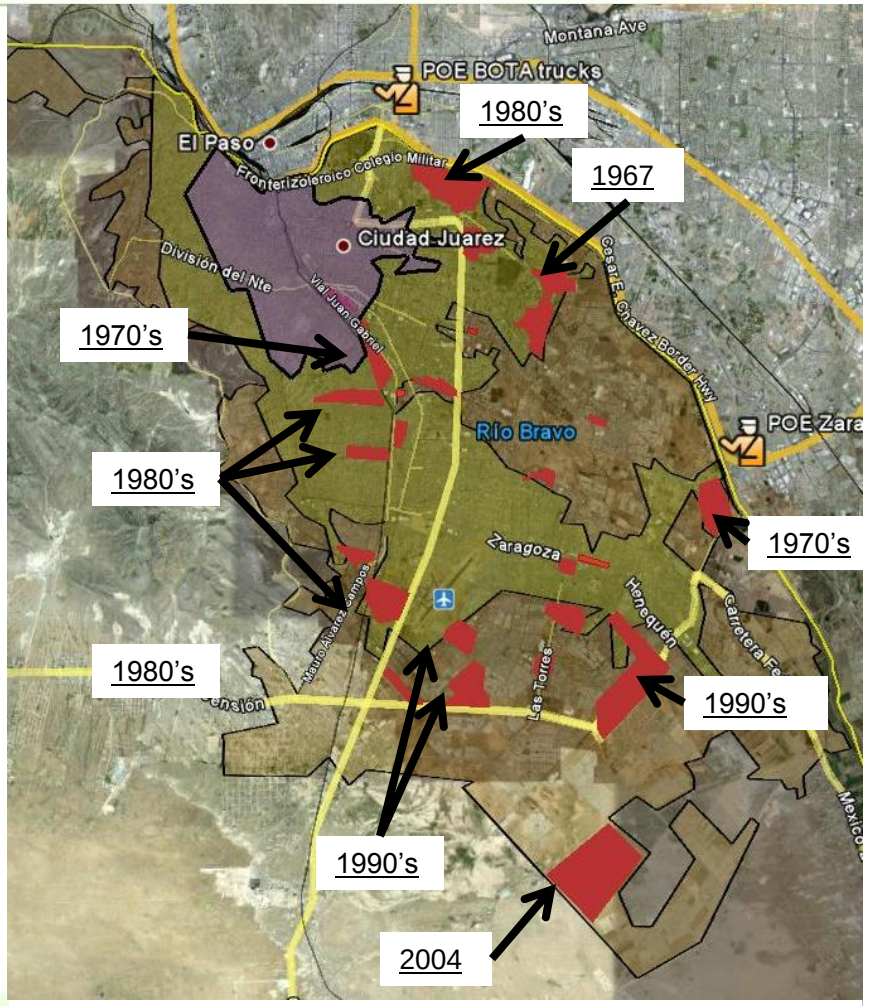
- Maquiladoras industry growth after 60's
- Ciudad Juarez could not keep up with the urban planning process.
- Lack of planning due to fast expansion of the city between the 60's and 90's
- Overloaded traffic network with mobility decreased.
- In spite of the growing security issues, new companies continue to set up factories in Ciudad Juarez which attract people migration



Ciudad Juarez growth 1960- 2011
Source: Google Map and CIG UACJ

Mobility issues in Ciudad Juarez

- The industrial parks that were once outside the city are now inside the city core.
- Trucks delays due to the use of local and often congested inner city streets to transport products and supplies from/to the maquiladoras between Ciudad Juarez/El Paso
- This situation affects the whole maquila industry
- Hence, the city needs to evaluate the current traffic network and evaluate how it affects the accessibility of personal and commercial vehicles, especially to industrial parks and to the ports of entry

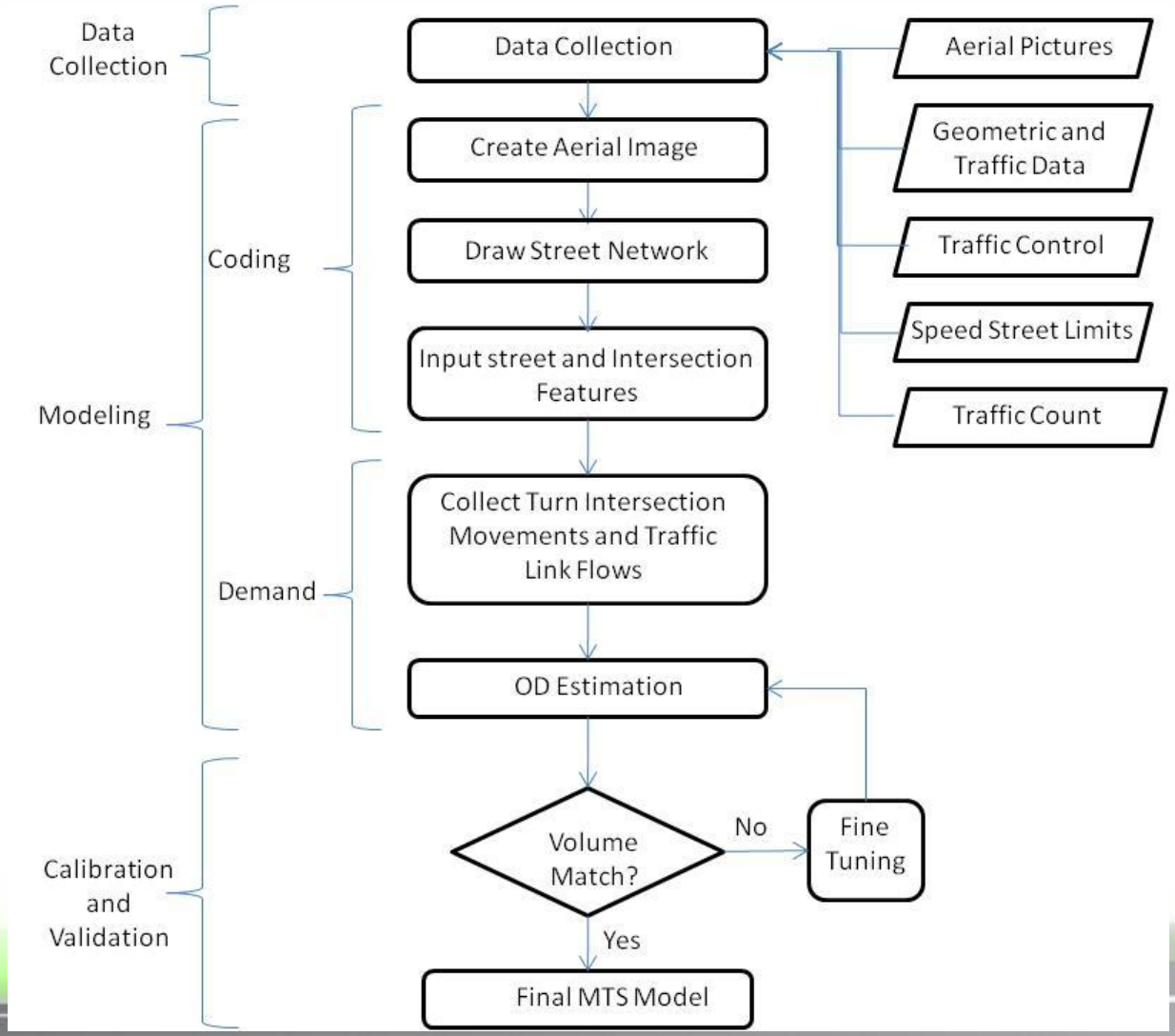


Location of industrial parks in Ciudad Juarez 2010
Source: Google Map and IMIP

Objective

- The objective of this particular project is to develop a traffic simulation model for the Ciudad Juarez to highlight the importance of using a large scale microscopic traffic simulation model to analyze the mobility of commercial vehicles within the city, especially between the industrial parks in Ciudad Juarez and both freight Ports of Entry (POEs)

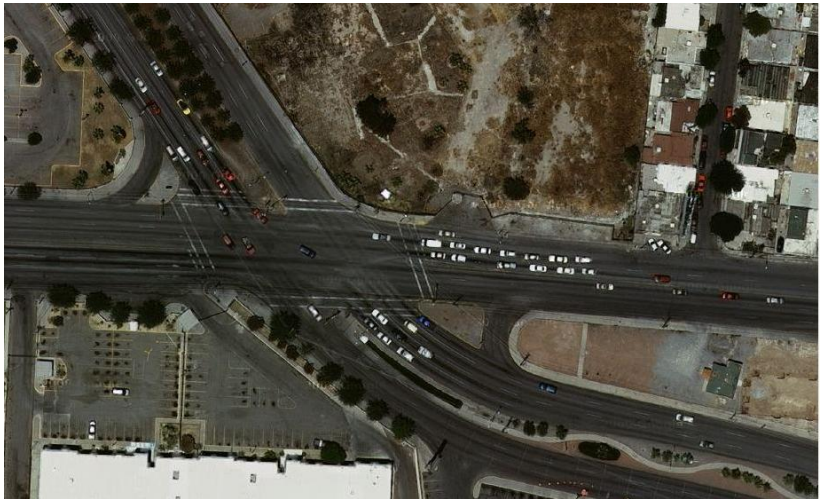
Methodology



Methodology: data collection

Street Geometry Data

- Field studies
- Aerial picture views from web sources like Google earth and Google map



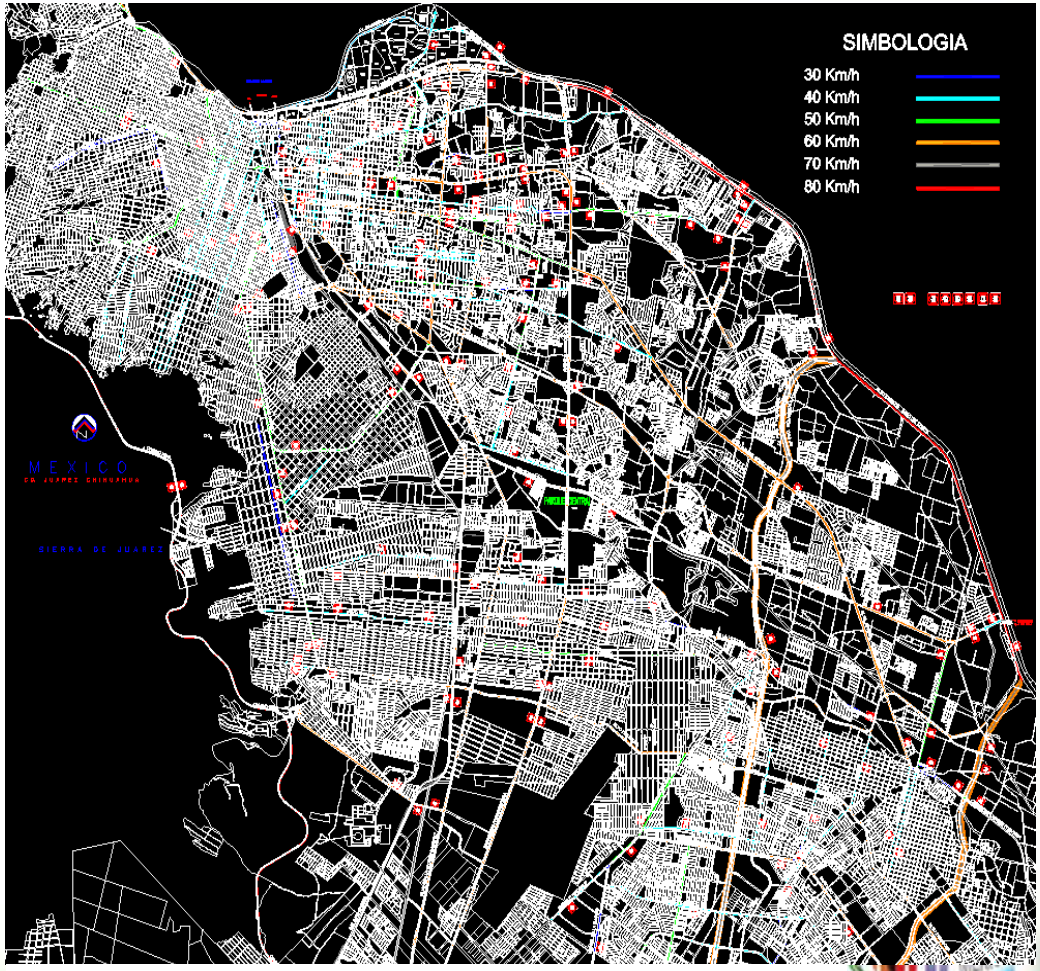
Aerial view of Vicente Guerrero Ave. and Tomas Fernandez Ave. intersection
Source: Google map

Aerial view of Gomez Morin Ave. and Tecnológico Ave. intersection
Source: Google map

Methodology: data collection

Speed data

- Range in the network is 80km/h (~50mph) to 15km/h (~9mph)
- School zones: 15km/h (~9mph)
- Downtown: 30km/h (~19mph)
- Local or residential streets: 40km/h (~25mph)
- Collector streets have 50km/h (~31mph)
- Main streets or avenues have 65km/h (~40mph)
- Independence freeway and Avenida de las Torres have 70km/h (~44mph)
- Border and Camino Real freeways: 80km/h (~50mph)

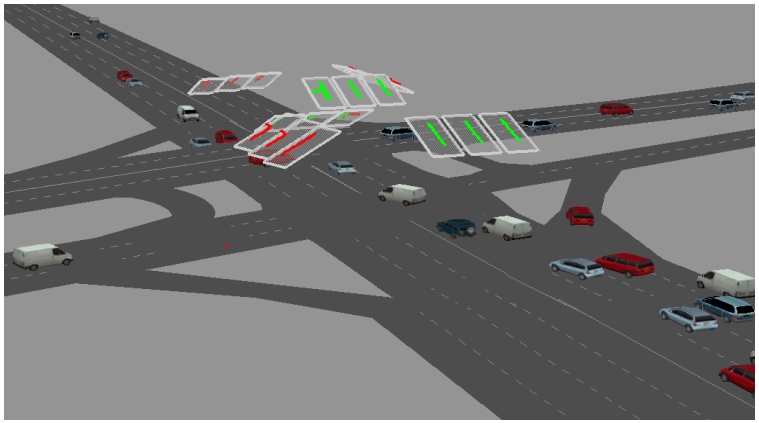


Speed limit of streets in Ciudad Juarez.
Source: Traffic Control department, Municipality of Ciudad Juarez

Methodology: data collection

Traffic Signals

- The data on signal timing of traffic lights were obtained from the traffic control office.
- 204 pre-timed traffic lights (238 total in the city)



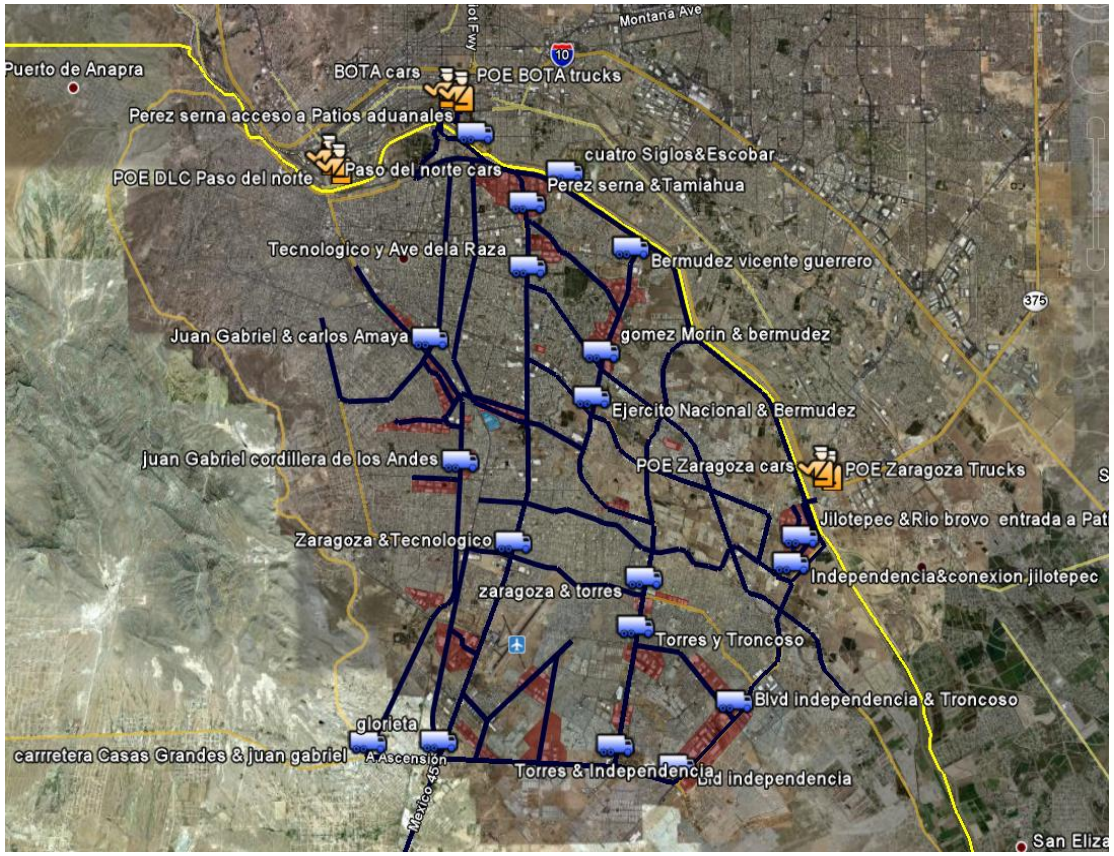
Snapshot of traffic light modeled .

Snapshot of the network modeled with traffic lights intersections

Methodology: data collection

Traffic volumes

- 19 turning movement data collections
- Intersection locations with trucks routes from maquiladoras and ports of entry with access to trucks.
- Obtained during typical days in the morning peak-hour (7:00-8:00).
- Classification of vehicles including the categories of cars, buses, trucks.



Intersection Movement Count Locations in Ciudad Juarez.
Source: Google Maps

Methodology: data collection

Traffic volumes

- Traffic counters data base provided by IMIP (Ciudad Juarez MPO).
- This data was used in links where trucks are not allowed to travel such as downtown and minor streets.
- Traffic from BOTA and Ysleta ports of entry were obtained from field studies.

Traffic Count Locations in Ciudad Juarez network
Source: IMIP

Methodology: modeling

Coding the street network

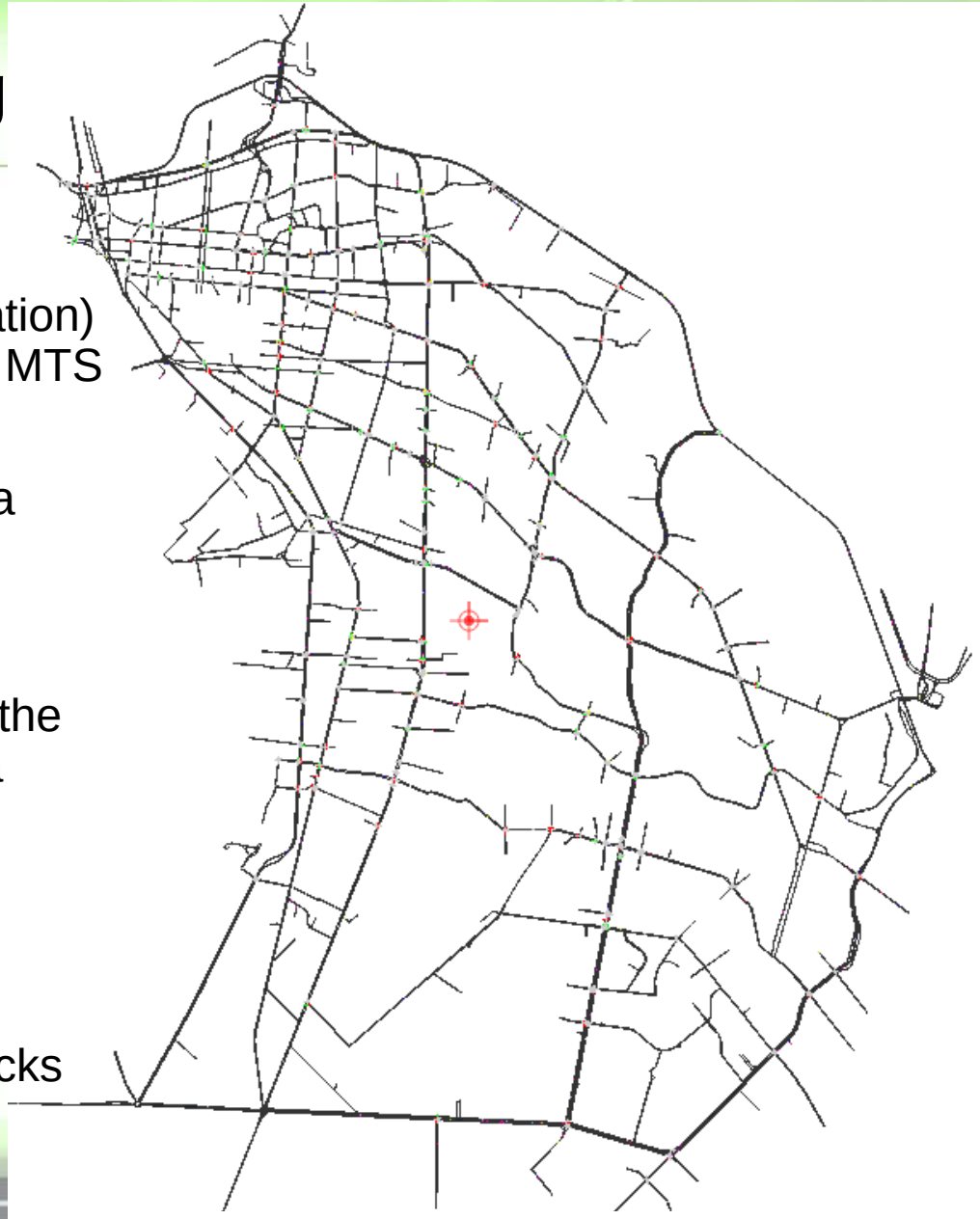
- Traffic lights and signal timings other traffic control locations
- Turning movement of each lane of intersections
- Traffic restrictions on certain vehicle types
- 5,513 links
- Total distance of 560miles
- 204 traffic signals

Snapshot of Ciudad Juarez Roadway Network in Paramics.

Methodology: modeling

Obtaining O-D

- Obtaining the demand (origin-destination) matrix to assign the traffic flow in the MTS model
- The traffic demand was obtained as a function of an estimated O-D_m.
- Data used:
  - 126 traffic counts obtained from the intersection movement field data collection
  - Ports of entry traffic counts
  - Data base provided by IMIP
- Two O-Ds obtained: Vehicle and Trucks



Snapshot of Ciudad Juarez Roadway Network in Paramics.

Methodology: Modeling

Calibration

Visual Process

- Evaluate the behavior of the traffic in the network
- Identify not precise O-D paths to represent movements of the traffic in the network
- Detect inappropriate behavior of vehicles in the network

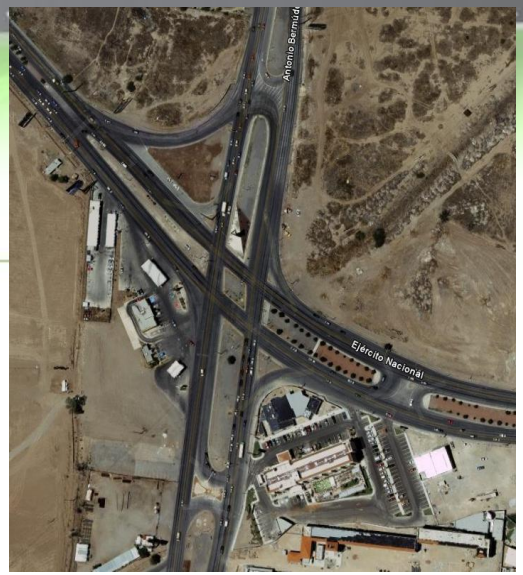
This evaluation applied to:

- Intersections
- Freeways
- Forbidden movements
- Traffic lights

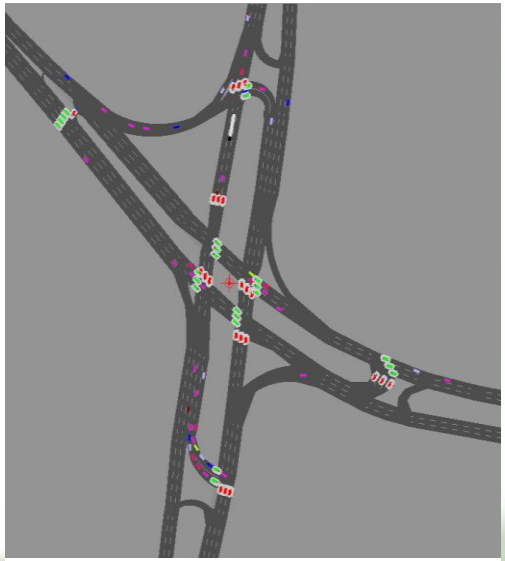
Traffic flow calibration

- Compare and fine-tuning traffic flow in the model.
- Traffic Observed and estimated is compared using GEH (Geoffrey E. Havers)

$$GEH = \sqrt{\frac{(M-O)^2}{0.5(M+O)}}$$



Aerial view of an Median U-Turn Intersection Treatment (MUTIT)
Source: Google



Snapshot of MUTIT Intersection

Results

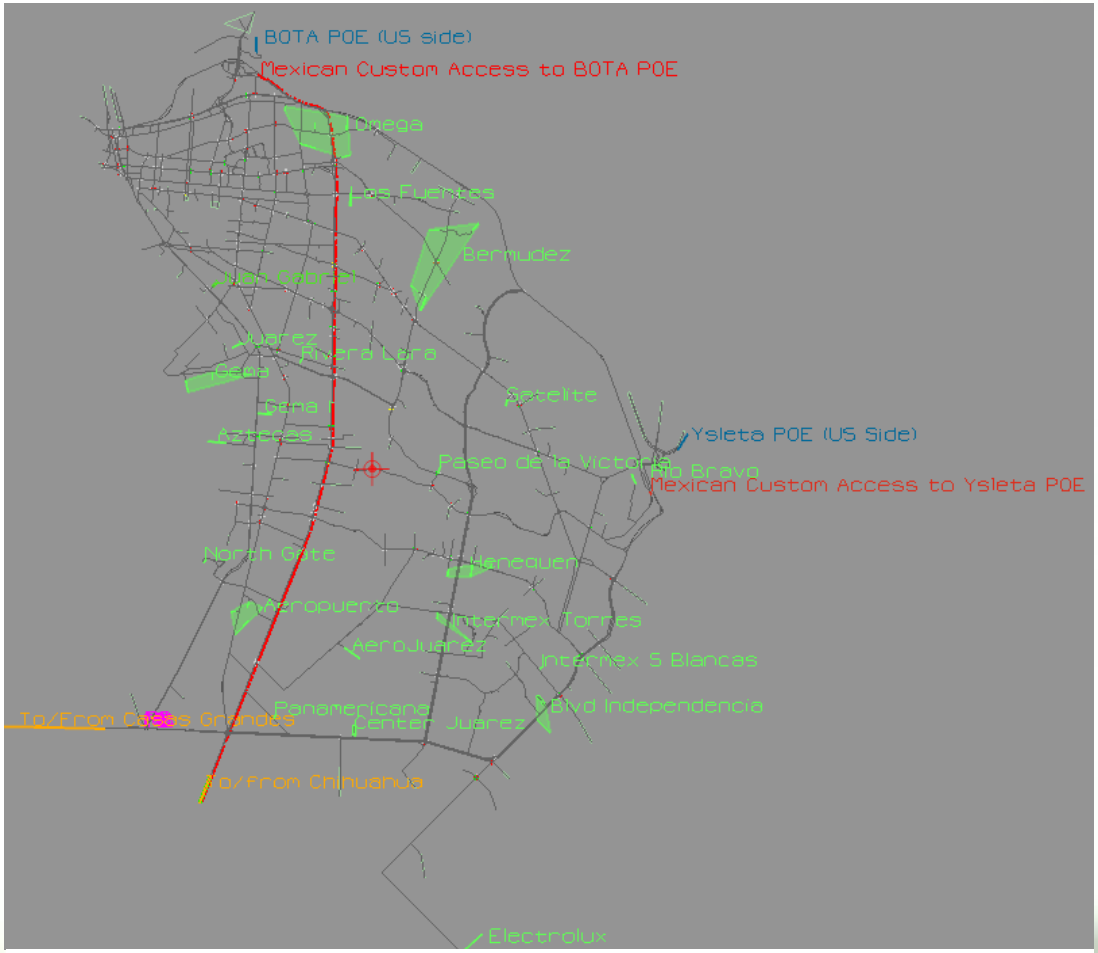
Analysis Considerations

- Origins: industrial parks and two main entrances for trucks
- Destinations: entrance of the Mexican customs facilities at the ports of entry.
- Truck routes represent the shortest time path available as result of assignment network process (dynamic feedback).
- Measurement of effectiveness: Modeled travel time and delay.
- Modeled travel time: total truck average travel time from origin to the destination.
- Delay: difference between the modeled travel time and free-flow travel time. Delay includes the average delay due to traffic congestion and traffic control devices.

Results

Truck paths

- Different paths obtained of trucks traveling from industrial parks of Ciudad Juarez to the entrance of Mexican custom facilities in the POEs: Ysleta and BOTA.
- The truck traffic from Chihuahua and Casas Grandes highways entering Ciudad Juarez with destination to both ports of entry also were evaluated

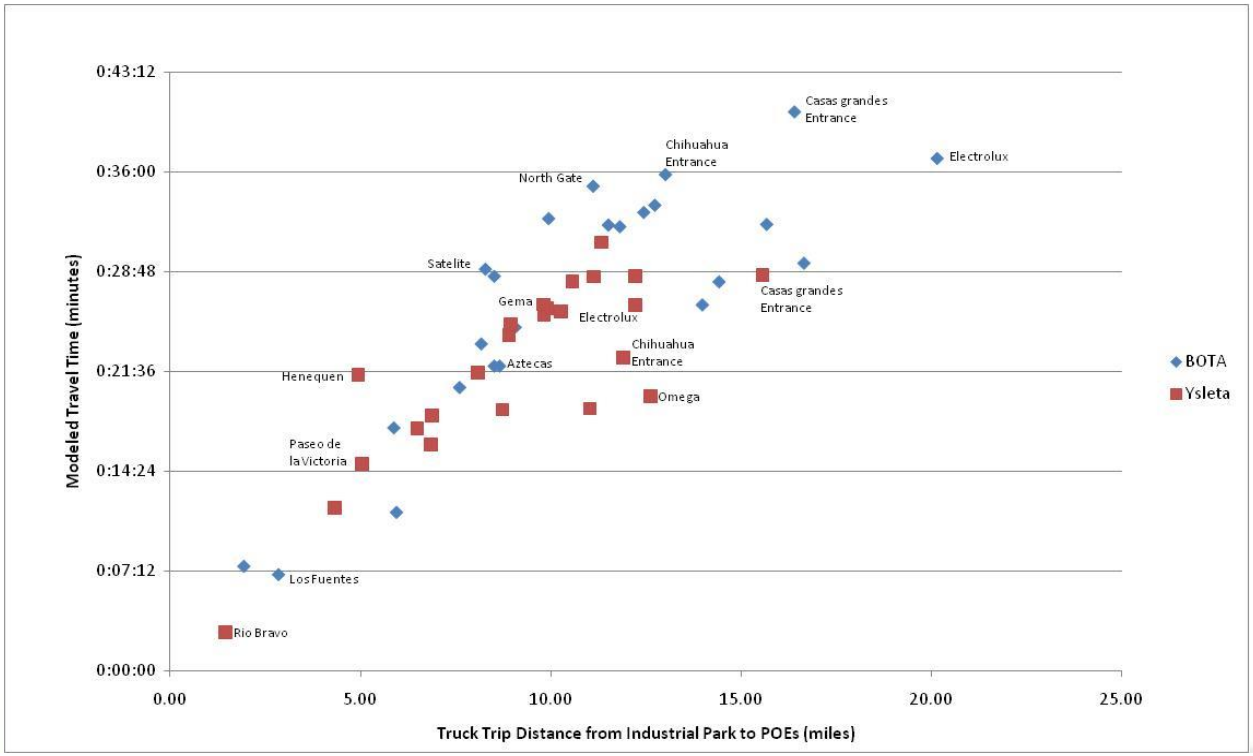


Industrial parks coded in the MTS model of Ciudad Juarez

Results

Delay caused by minor streets

- Total modeled travel time indicate that the longer the travel distance connecting them the longer the travel time

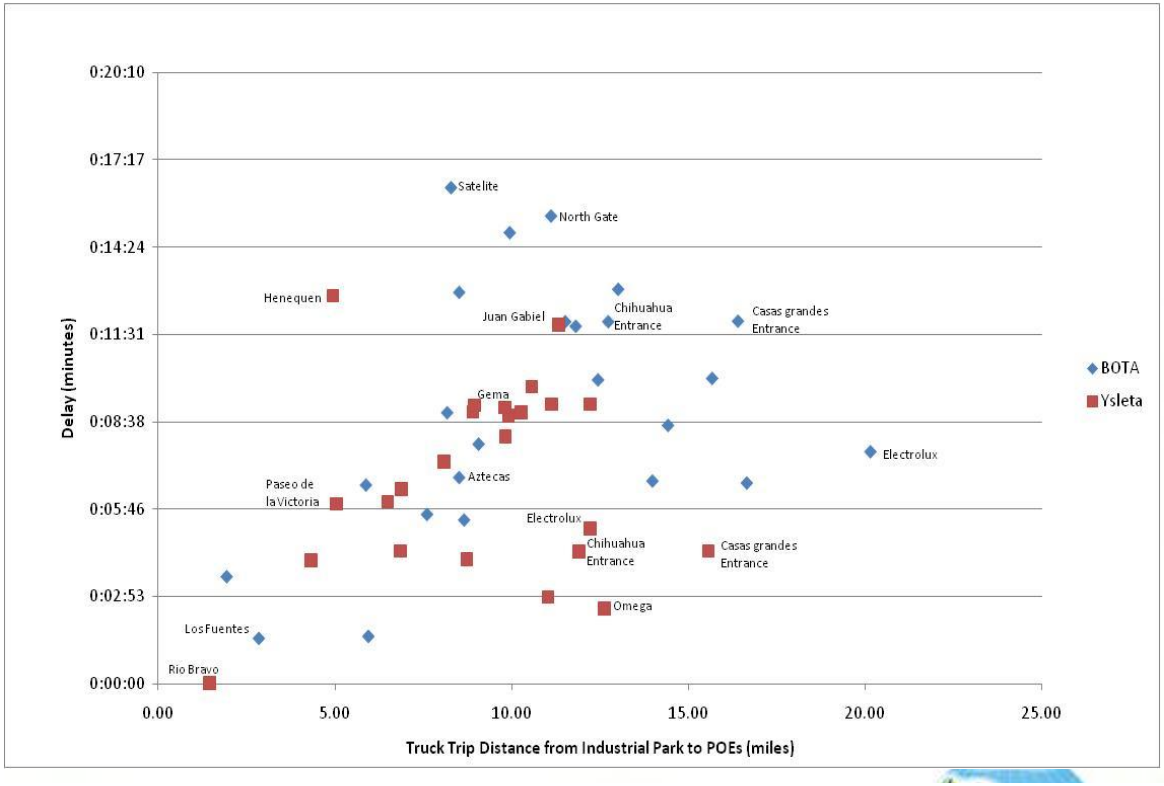


Comparison of simulated travel of commercial vehicles between individual industrial parks and both ports of entry (Travel Time – Trip Distance)

Results

Delay caused by minor streets

- Delay is not correlated with the travel distance
- Delay is caused by the traffic of the network particularly in minor streets.
- Trucks with longer trips using freeway corridors have lower delay than trucks with shorter distance trips that use urban streets which are usually congested.

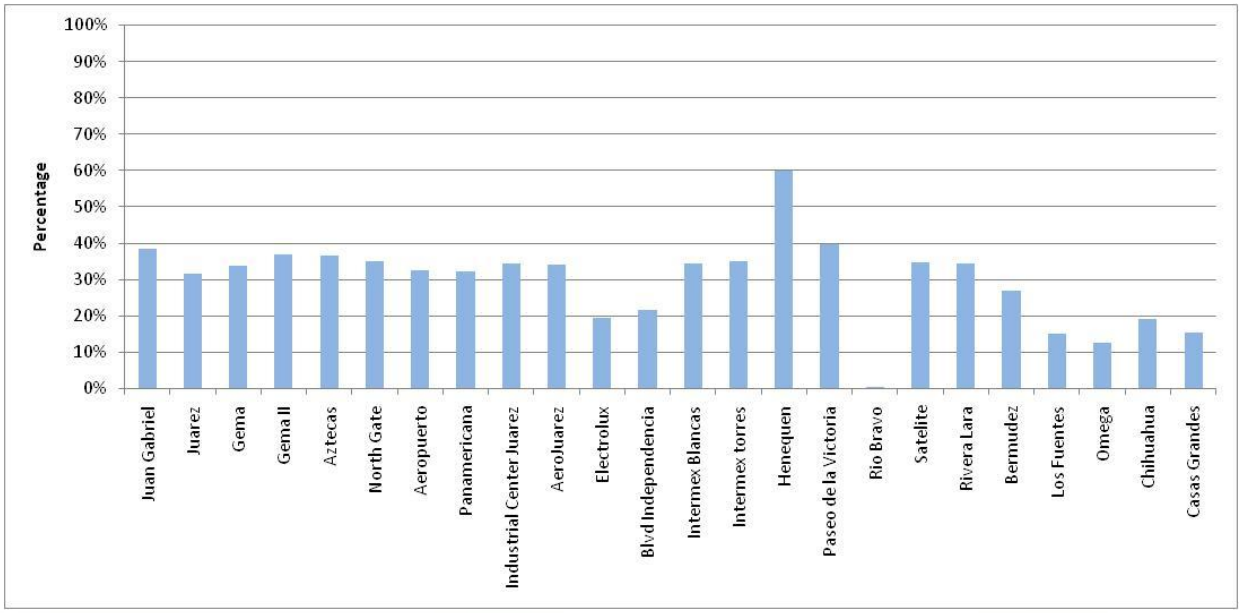


Comparison of delay of commercial vehicles between individual industrial parks and both ports of entry (Delay– Trip Distance).

Results

Average Percentage of delay

- Average percentage of delay incurred to trucks traversing between industrial parks and the Ysleta port of entry is approximately 32% of the total travel time.

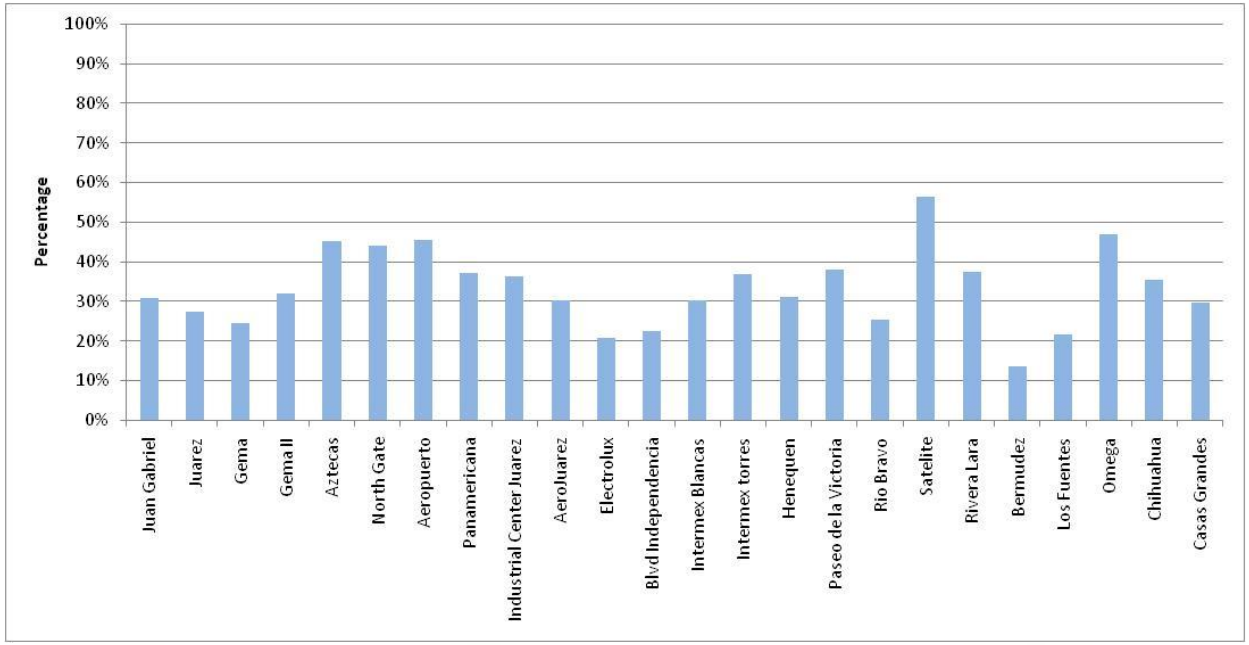


Percentage of delay incurred to trucks originating from different industrial parks and both highway entrances to Ysleta (Zaragoza Bridge) port of entry

Results

Average Percentage of delay

- In the case of the port of entry BOTA, delays represent a 35% of the total travel time.

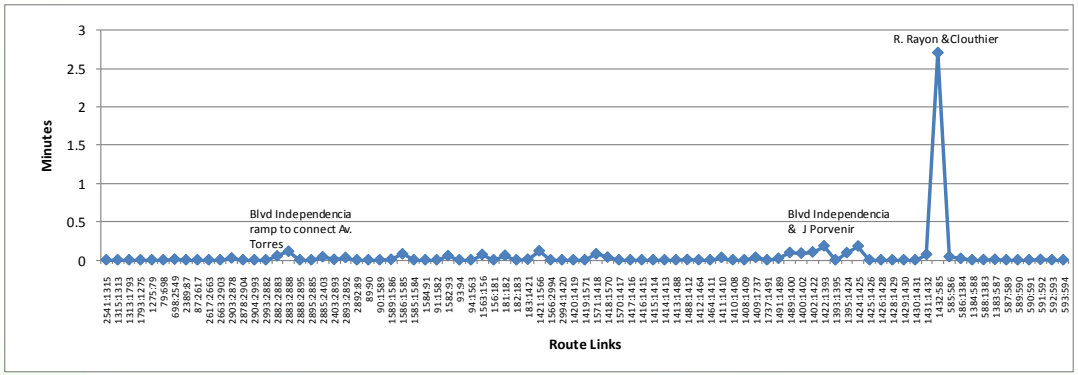


Percentage delay incurred to trucks originating from different industrial parks and both highway entrances to BOTA (Americas) port of entry

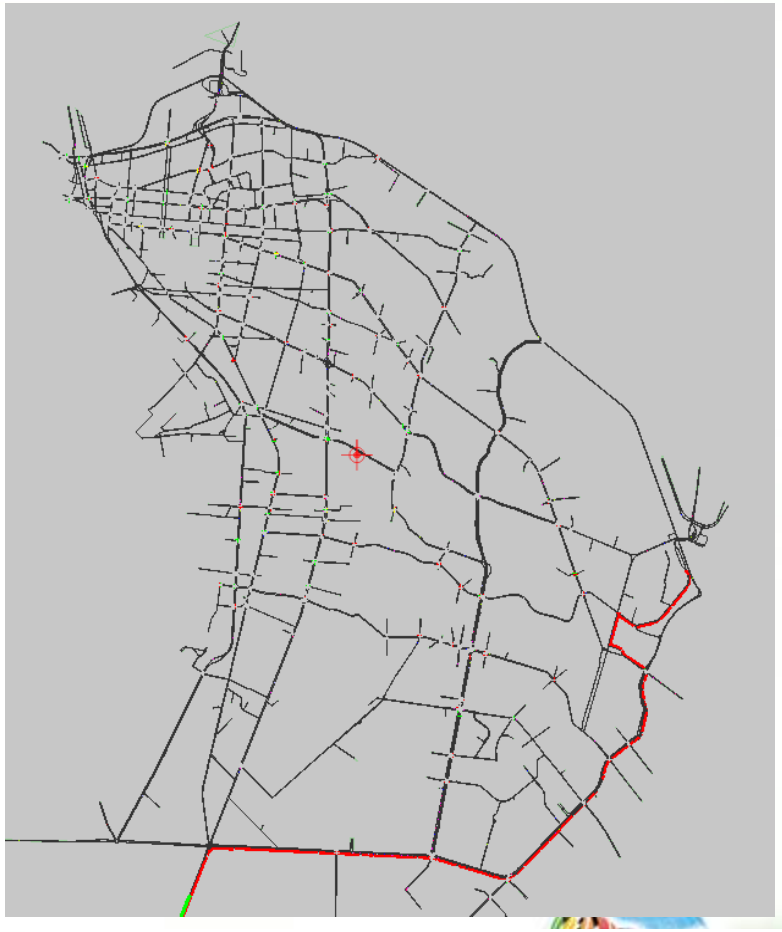
Results

Delay on truck paths segments

- The simulation model also provides delay incurred by trucks on different segments that form a path of trucks traveling from the industrial parks and highway entrances to both ports of entry.
- Chihuahua highway entrance to the Ysleta port of entry path.



Delay on segments of a path from the Chihuahua highway entrance to the Ysleta port of entry.

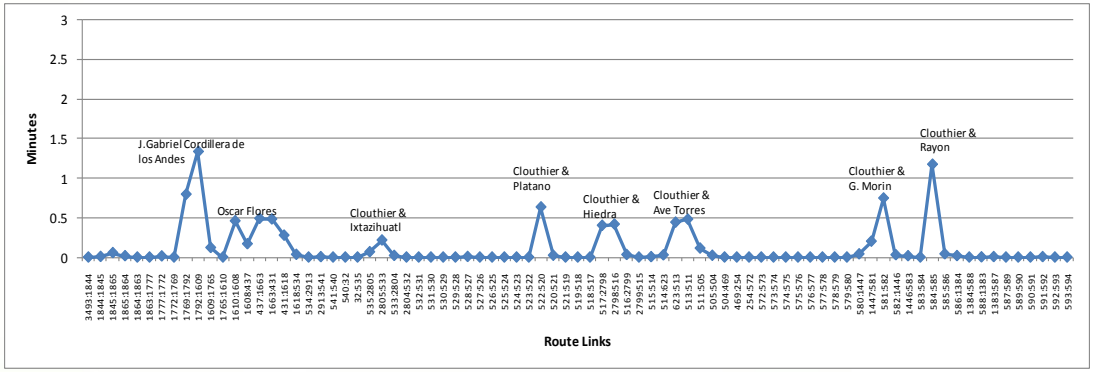


Path of trucks traveling from the Chihuahua highway entrance to the Ysleta port of entry

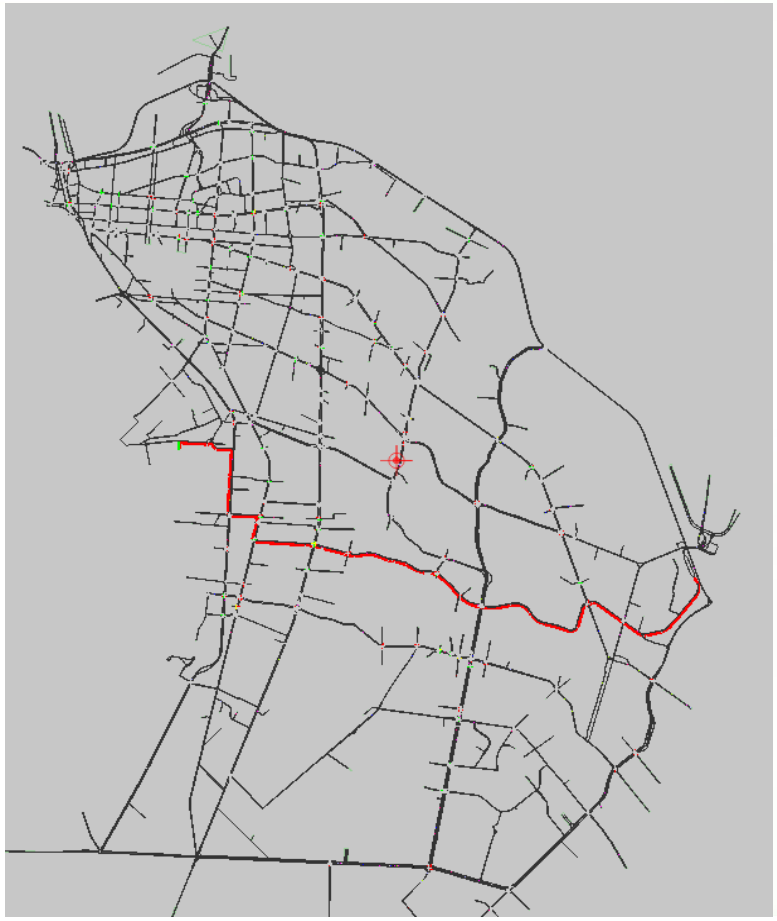
Results

Delay on truck paths segments

- I.P. Gema and Ysleta POE path



Delay on segments of a path from Gema to the Ysleta port of entry

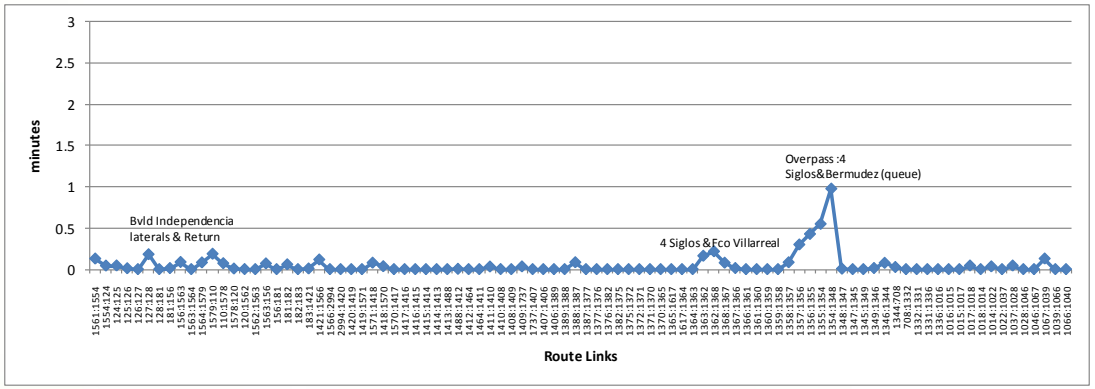


Path of trucks traveling from Gema to the Ysleta port of entry

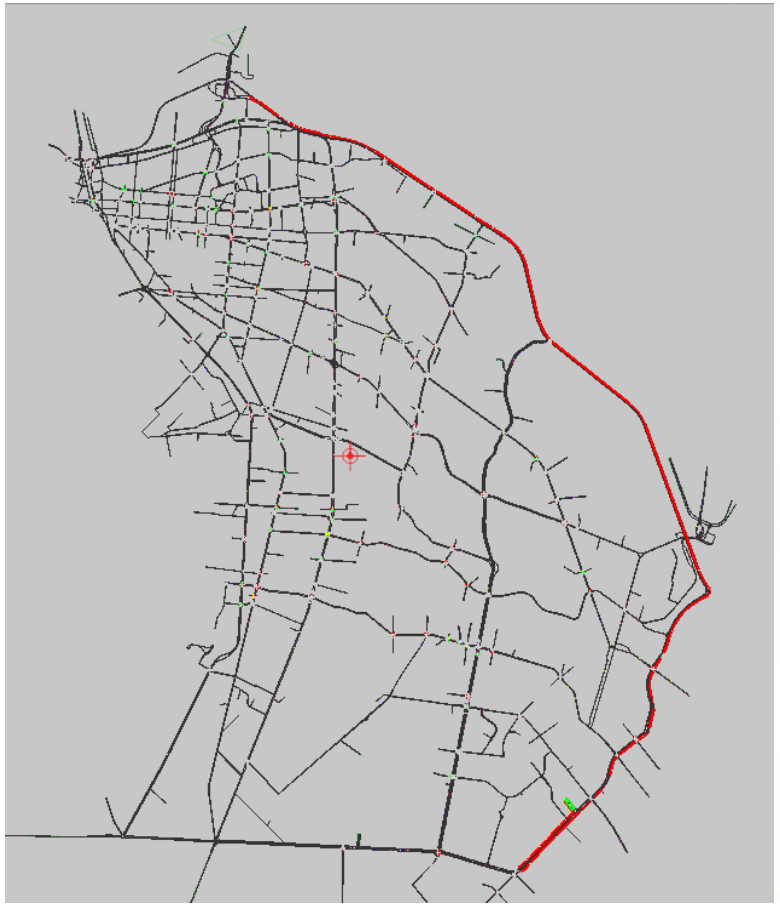
Results

Delay on truck paths segments

- I.P. Independencia to the BOTA port of entry



Delay on segments of a path from Independencia to the BOTA port of entry

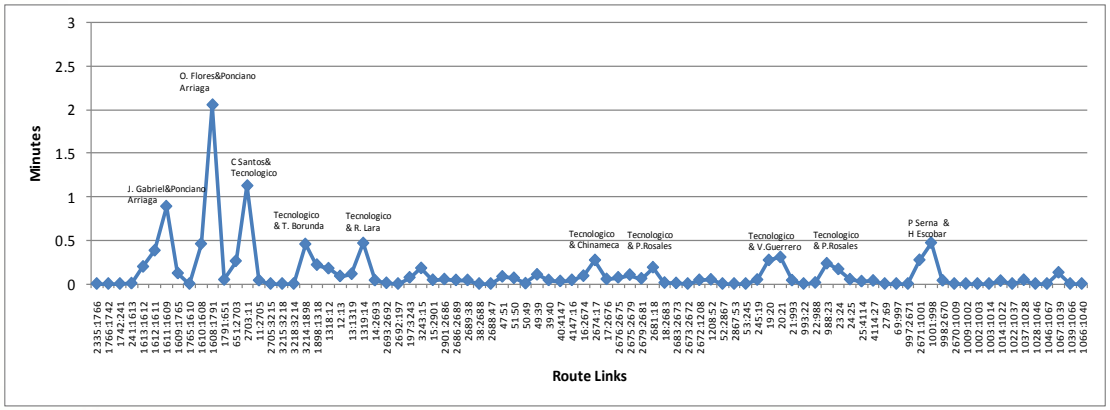


Path of trucks traveling from Independencia to the BOTA port of entry

Results

Delay on truck paths segments

- I.P. Aztecas to BOTA port of entry

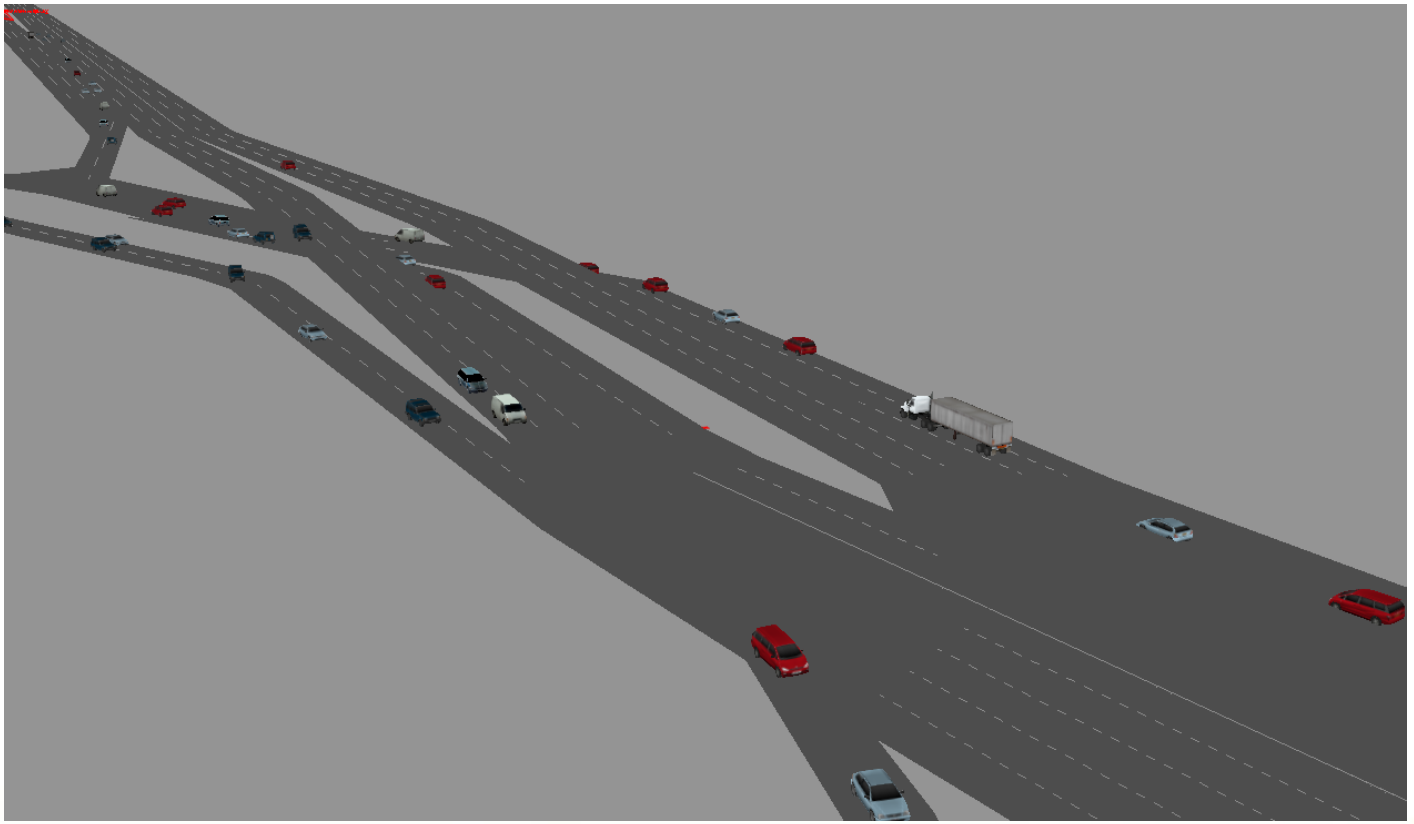


Link delay of the path of trucks traveling from I.P. Aztecas to BOTA port of entry

Path of trucks traveling from Aztecas to BOTA port of entry

Results

Visualization

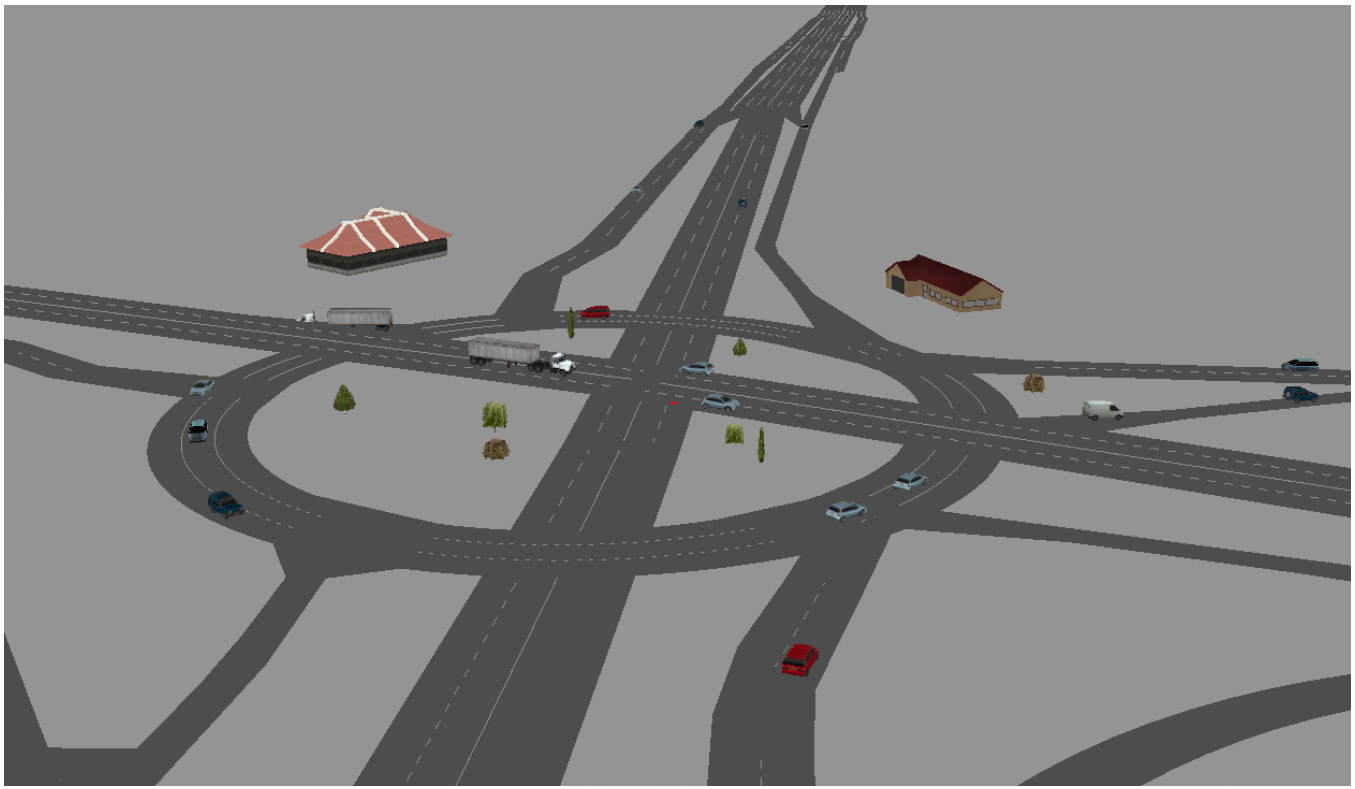


Results

Visualization

Results

Visualization



Conclusions

- The simulation model developed in this research demonstrated various scenarios of truck paths connecting industrial parks to ports of entry.
- The analysis showed that the delay on truck paths is attributed to congestion in the inner urban areas, while freeways surrounding the city provide reliable access to the ports of entry
- Delay contributes to 30-40% of the travel time of trucks moving between industrial parks and the ports of entry
- Delay translates into higher cost of shipping and moving goods
- The results derived from the model will relay a strong need for improved planning and operation of transportation infrastructure in Ciudad Juarez
- The MTS model provides to planners and decision makers tools to improve the flow of trucks and develop infrastructure improvement plans benefiting the borderplex economy

Thank you

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