

Development of a Regional Truck Model for the Santa Clara Valley Transportation Authority

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Introduction

- Truck traffic: An important component for transportation planning and engineering projects.
- One of Measures in Project Study Report/Project Reports (PSR/PR) and Environmental Impact Report/ Environmental Impact Statements (EIR/EIS).
- Heavy truck traffic: results in more emissions, potential health, safety, environmental burdens, and increased traffic congestion, compared to the equivalent passenger vehicle traffic.



Introduction

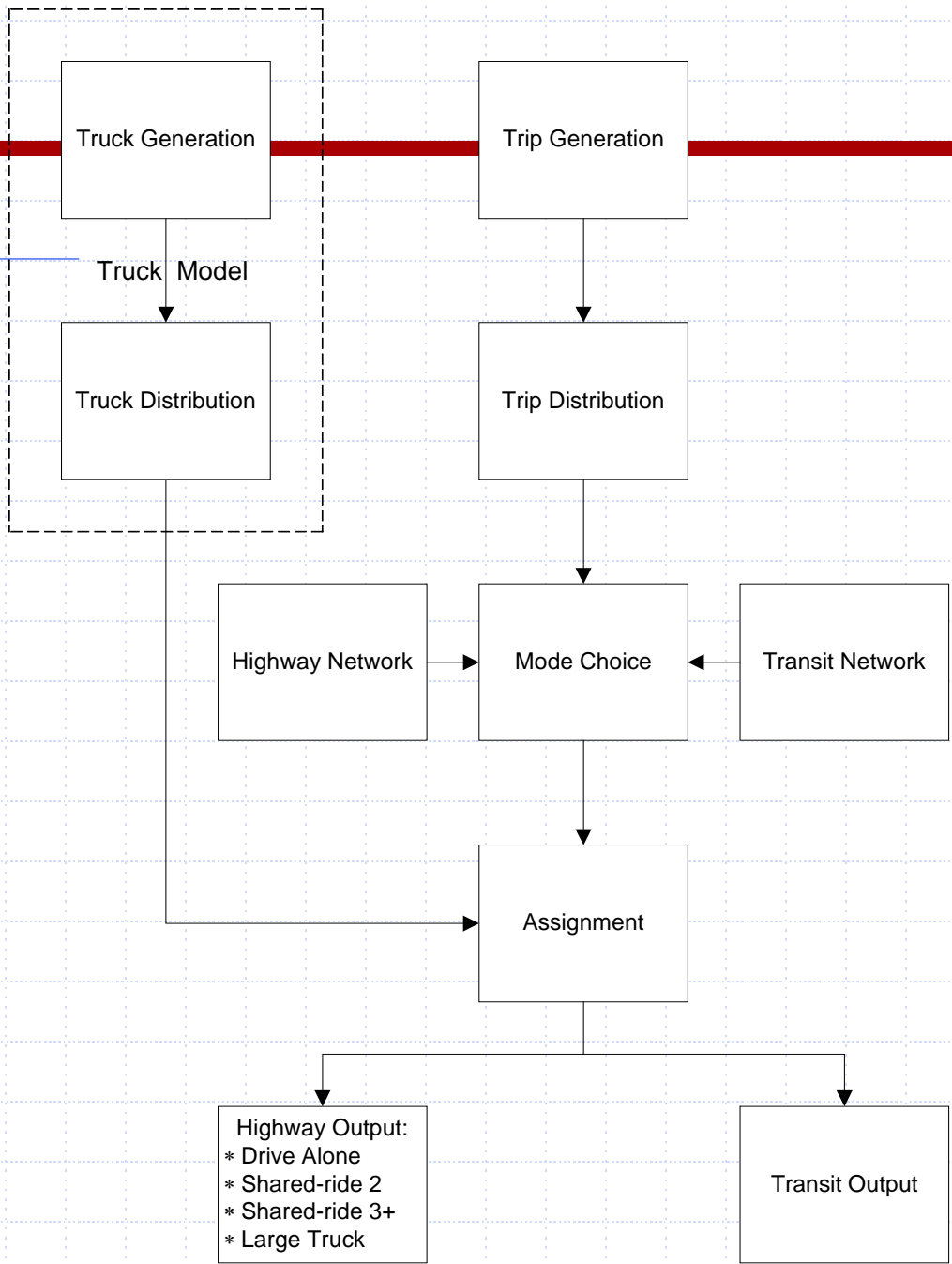
- The VTA model was built under the structure of Metropolitan Transportation Commission (MTC) regional model using the existing **MTC truck trip rate method** applied to socioeconomic data such as jobs by type to generate truck trips. The models were not validated to truck traffic counts.
- The purpose of this study was to develop an enhanced truck demand model **with a validation** based on comparing truck data collected from various public agencies and considering **heavy truck trip generators** to model estimated volumes.



Previous Truck Model

- Truck Trips Generated by Applying Truck Trip Rates from MTC Regional Model (Internal Truck Trips Only).
- No Special Truck Trip Generators
- Truck Type: Large (4-axle and plus)
- No External Truck Volumes

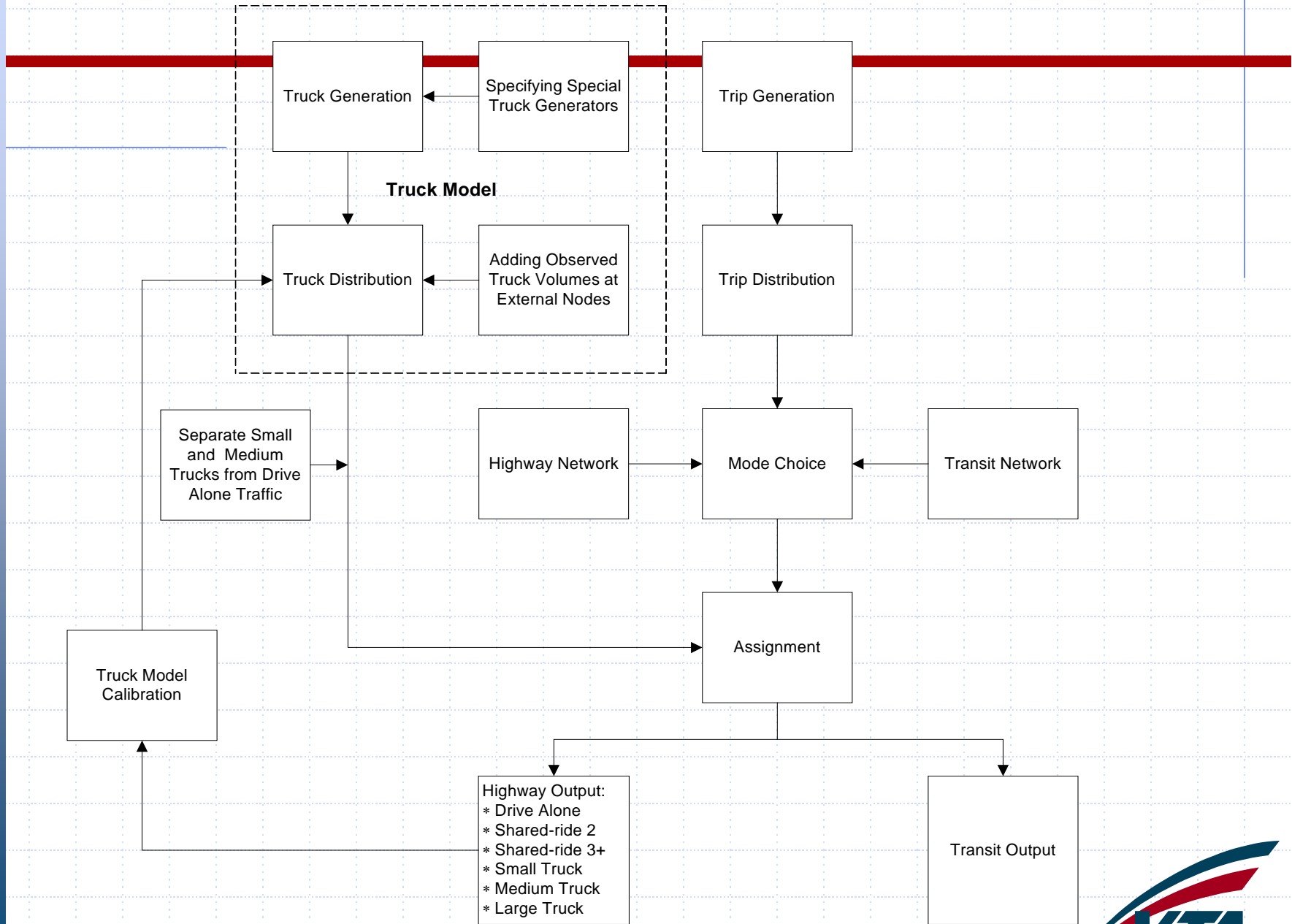




Improved Truck Model

- Special Truck Trip Generator: Port of Oakland
- Truck Type: Small (2-axle), Medium (3-axle), and Large (4-axle and plus)
- External Truck Volumes: 22 External Nodes Truck Counts





Available Truck Counts

- California Department of Transportation (Caltrans)
Truck Traffic Counts
- Freeway Performance Measurement System (PEMS)
Database





vtamodel.cat

Scenarios

- Base
 - Year 2030
 - Year 2000
 - Year 2005
 - Base
 - Year 2015
 - Year 2010
 - Year 2035

Applications

- MODELUPDATE

Data

- Inputs
- Outputs
- Reports

Keys

Key	Value
Scen. Name	Base
FileLocation	e:\2008\wtp2005\
HighwayNet	et_052008.net
Year	2005
LandUseData	ta\zmast05.dbf
AmbagPA	bagpa2005.dbf
NGCost	6.41
GCost	9.61
YearAbr	05
TermLOS	ata\azlos05.dat
TollValue1	95





vtamodel.cat

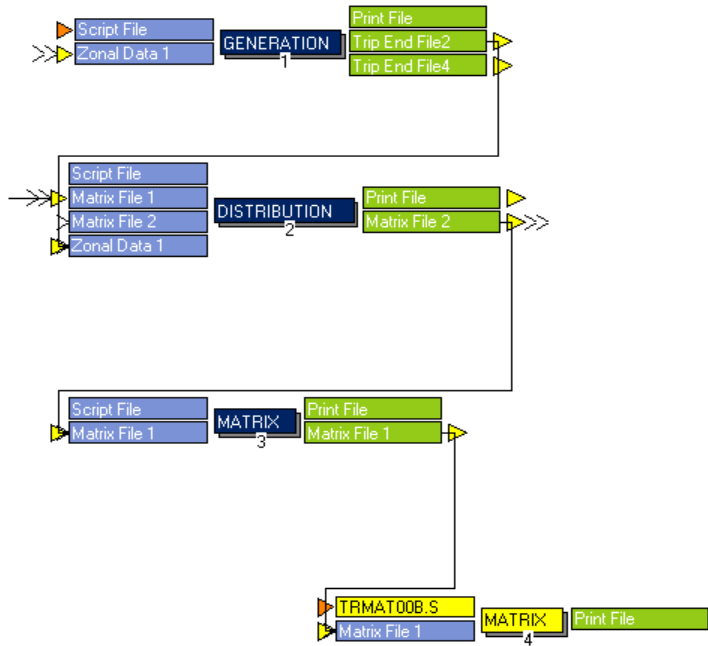
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Truck Model – Trip Generation

- Truck trip rates used in the previous VTA model were derived from the original MTC model, which were based on a 1991 report prepared by Barton-Aschman Associates, Inc

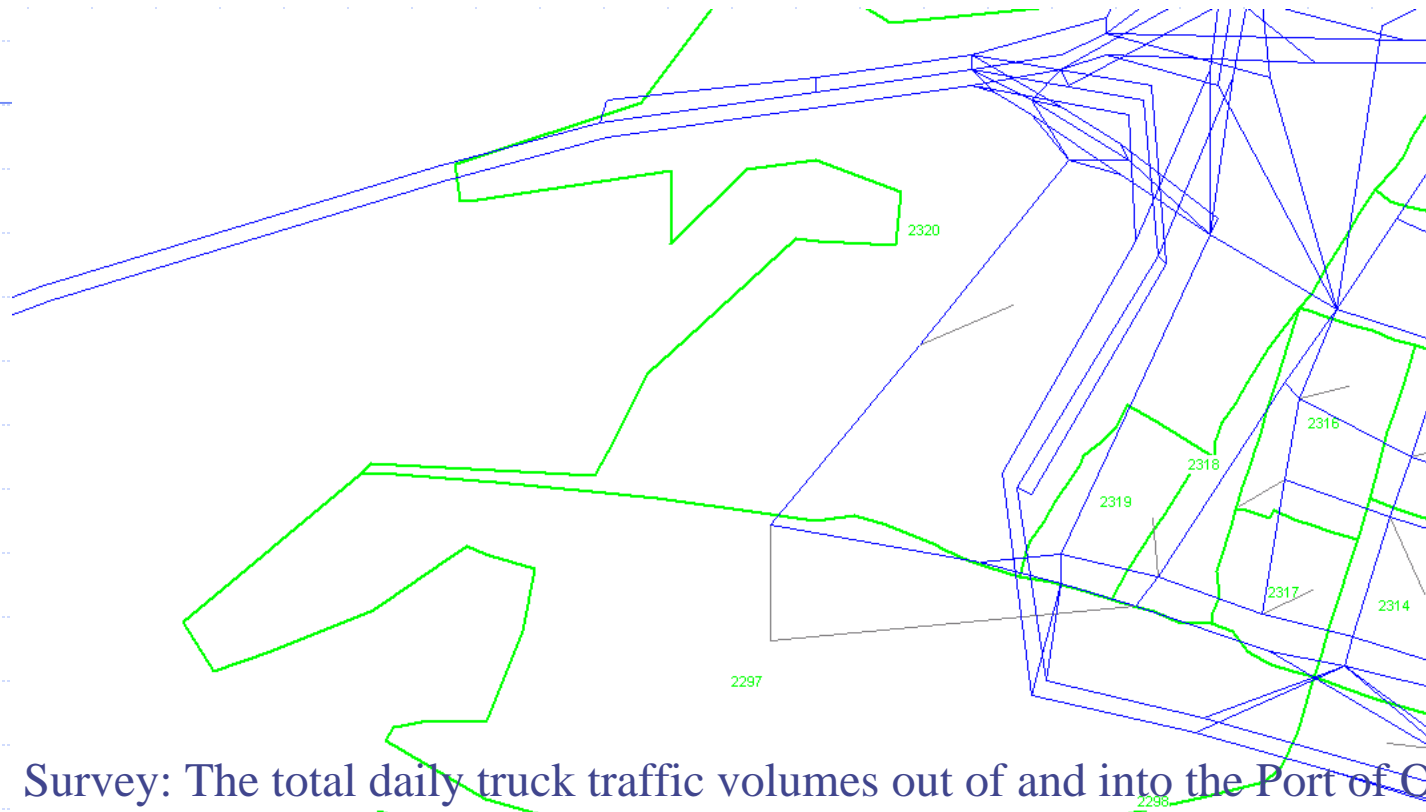
	Garaged Trips	Non-Garage Trips
Production		
Small Truck, 2-axle	0.011*manemp + 0.014*retemp+ 0.0105*seremp + 0.046*(othemp+whoemp+agemp)	0.0324*temp
Medium Truck, 3-axle	0.0014*manemp + 0.000124*retemp+ 0.0037*(othemp+whoemp+agemp)	0.0039*temp
Large Truck, 4-axle +	0.004*manemp + 0.0027*seremp + 0.0084*(othemp+whoemp+agemp)	0.0073*temp
Attraction		
Small Truck, 2-axle	0.0234*temp	0.0324*temp
Medium Truck, 3-axle	0.0046*temp	0.0039*temp
Large Truck, 4-axle +	0.0136*temp	0.0073*temp

NOTE:

- temp: total employments
retemp: retail employments
seremp: service employments
whoemp: wholesale employments
agemp: agriculture employments
othemp: other employments
- Non-Garaged trips are linked truck trips that make intermediate stops. Garaged trips travel back and forth between a base (garage) location and destination.



Truck Model – Trip Generation



- Survey: The total daily truck traffic volumes out of and into the Port of Oakland were **3,260 trips** (production) and **3,030 trips** (attraction) (in 2003).
[TIAX LLC, “Container Truck Traffic Assessment and Potential Mitigation Measures for the West Oakland Diesel Truck Emission Reduction Initiative”, September 2003]
- Simplified Truck Trip Rate Method: Only **400 trips** (production) and **347 trips** (attraction), which significantly underestimates the truck generation in the Port of Oakland, by about **800 percent** of the observed truck counts.

Truck Model – Trip Generation

- Special Truck Trip Generators

Distribution Proportions of Truckers in the Bay Area: Alameda County 27%, Santa Clara County 21%, Contra Costa County 14%, and San Mateo County 10% *

Alameda County has the highest concentration of important industrial and distribution business locations in Bay area:

- Port of Oakland
- Oakland International Airport
- New United Motor Manufacturing (NUMMI) Auto Assembly Plant
- Union Pacific Intermodal Facilities

Other important truck generators in Bay Area:

- San Francisco International Airport
- San Jose International Airport

* Kimley-Horn and Associates, Inc. Central Alameda County Freeway System Operational Analysis/Task 6 – Existing and Future Goods Movement, Alameda County Congestion Management Agency, February 2007.



Truck Model - Highway Assignment

- Previous Model

```
,*****  
IF (LI.USE=2,3) ADDTOGROUP=23 ;for SR2 and SR3+ trips  
IF (LI.USE=3) ADDTOGROUP=3 ;for SR3+ trips  
IF (LI.USE=2,3,4) ADDTOGROUP=4 ;for truck trips (large, 4 axles)  
,*****  
PHASE=ILOOP ;assigns trips from each origin zone  
PATHLOAD PATH=TIME, PENI=1, EXCLUDEGRP=23, VOL[1]=MI.1.1 ;DA Trips  
PATHLOAD PATH=TIME, PENI=1, EXCLUDEGRP=3, VOL[2]=MI.1.2 ;SR2 Trips  
PATHLOAD PATH=TIME, PENI=1, VOL[3]=MI.1.3 ;SR3+ Trips  
PATHLOAD PATH=TIME, PENI=1, EXCLUDEGRP=4, VOL[4]=MI.1.4 ;Truck Trips (large, 4 axles)
```

- Improved Model

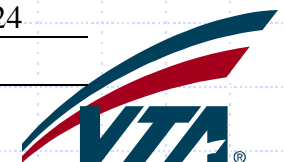
```
,*****  
IF (LI.USE=2,3) ADDTOGROUP=23 ;for SR2 and SR3+ trips  
IF (LI.USE=3) ADDTOGROUP=3 ;for SR3+ trips  
;IF (LI.USE=2,3,4) ADDTOGROUP=4 ;for truck trips (small, 2 axles)  
;IF (LI.USE=2,3,4) ADDTOGROUP=4 ;for truck trips (medium, 3 axles)  
IF (LI.USE=2,3,4) ADDTOGROUP=4 ;for truck trips (large, 4 axles)  
,*****  
PHASE=ILOOP ;assigns trips from each origin zone  
PATHLOAD PATH=TIME, PENI=1, EXCLUDEGRP=23, VOL[1]=MI.1.1 ;DA Trips  
PATHLOAD PATH=TIME, PENI=1, EXCLUDEGRP=3, VOL[2]=MI.1.2 ;SR2 Trips  
PATHLOAD PATH=TIME, PENI=1, VOL[3]=MI.1.3 ;SR3+ Trips  
PATHLOAD PATH=TIME, PENI=1, EXCLUDEGRP=23, VOL[4]=MI.1.4 ;Truck Trips (small, 2 axles)  
PATHLOAD PATH=TIME, PENI=1, EXCLUDEGRP=4, VOL[5]=MI.1.5 ;Truck Trips (medium, 3 axles)  
PATHLOAD PATH=TIME, PENI=1, EXCLUDEGRP=4, VOL[6]=MI.1.6 ;Truck Trips (large, 4 axles)
```



Performance of Previous and Improved Models

- Comparisons of PEMS Counts and Model Volumes for Previous and Improved Truck Models , Peak Hour

	AM Peak Hour			PM Peak Hour		
	PEMS	Model	Model/ PEMS	PEMS	Model	Model/ PEMS
Previous Model						
Small Truck, 2-axle	6,024	-	-	5,264	-	-
Medium Truck, 3-axle	1,403	-	-	1,225	-	-
Large Truck, 4-axle +	6,409	1,273	0.20	5,701	1,224	0.21
Total Truck	13,836	-	-	12,190	-	-
Total Traffic	296,259	356,321	1.20	300,018	374,248	1.25
Truck/Total Traffic	4.7%	-		4.1%	-	
Improved Model						
Small Truck, 2-axle	6,024	5,047	0.84	5,264	4,425	0.84
Medium Truck, 3-axle	1,403	1,259	0.90	1,225	1,024	0.84
Large Truck, 4-axle +	6,409	6,469	1.01	5,701	5,977	1.05
Total Truck	13,836	12,775	0.92	12,190	11,426	0.94
Total Traffic	296,259	355,143	1.20	300,018	371,431	1.24
Truck/Total Traffic	4.7%	3.6%		4.1%	3.1%	



Performance of Previous and Improved Models

- Comparisons of PEMS & Caltrans Counts and Model Volumes for Previous and Improved Truck Models, Daily

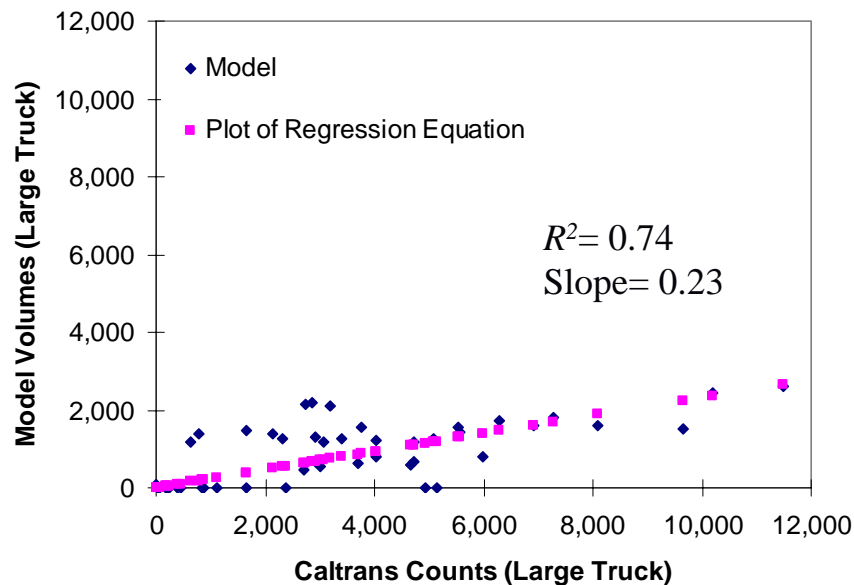
	Daily					
	PEMS	Model	Model/ PEMS	Caltrans Counts	Model	Model/ Caltrans
Previous Model						
Small Truck, 2-axle	103,934	-	-	111,418	-	-
Medium Truck, 3-axle	24,770	-	-	27,532	-	-
Large Truck, 4-axle +	113,455	38,350	0.34	126,384	38,350	0.30
Total Truck	242,159	-	-	265,334	-	-
Total Traffic	4,590,983	4,694,713	1.02	4,823,000	4,694,713	0.97
Truck/Total Traffic	5.3%	-	-	-	-	-
Improved Model						
Small Truck, 2-axle	103,934	112,791	1.09	111,418	112,791	1.01
Medium Truck, 3-axle	24,770	32,556	1.31	27,532	32,556	1.18
Large Truck, 4-axle +	113,455	124,842	1.10	126,384	124,842	0.99
Total Truck	242,159	270,189	1.12	265,334	270,189	1.02
Total Traffic	4,590,983	4,778,622	1.04	4,823,000	4,778,622	0.99
Truck/Total Traffic	5.3%	5.7%	-	5.5%	5.7%	-



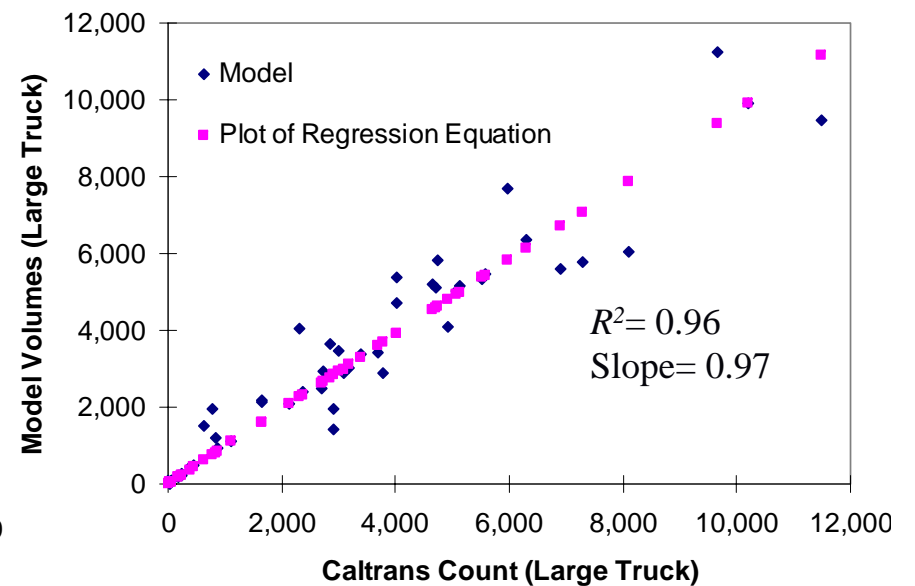
Performance of Previous and Improved Models

- Daily Large Truck Model Volumes vs. Caltrans Counts

(a) Previous Model



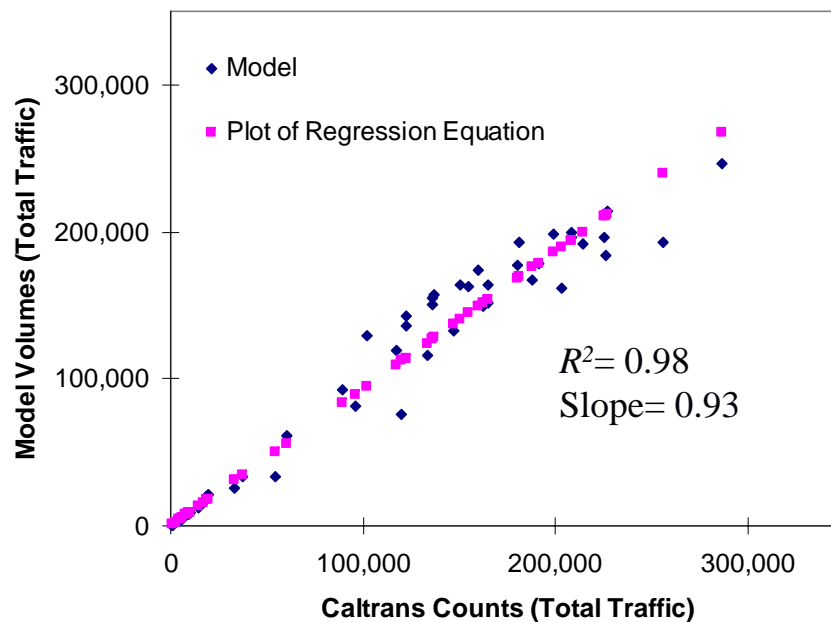
(b) Improved Model



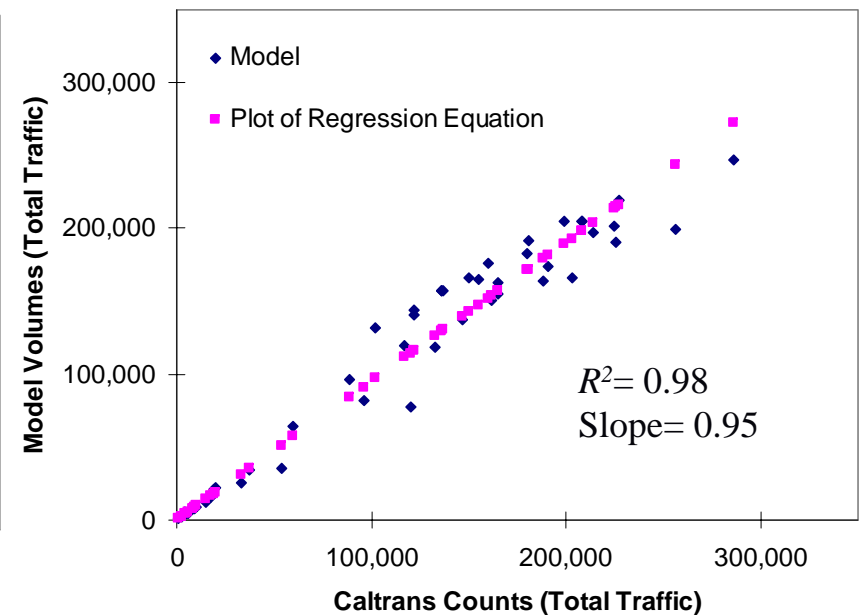
Performance of Previous and Improved Models

- Daily Total Vehicle Volumes vs. Caltrans Counts

(a) Previous Model



(b) Improved Model



Analysis of Selected Highway Corridors

- Comparisons of Caltrans Counts and Model Volumes by Observed Locations



	Caltrans Counts	Previous		Improved Model – Addition of External Trucks Only		Improved Model – External Trucks & Special Truck Generator in Port of Oakland	
		Model	Model/ Caltrans	Model	Model/ Caltrans	Model	Model/ Caltrans
US-101							
Small Truck, 2-axle	35,914	-	-	33,476	0.93	33,571	0.93
Medium Truck, 3-axle	6,601	-	-	3,676	0.56	6,712	1.02
Large Truck, 4-axle +	24,012	11,217	0.47	26,651	1.11	26,527	1.10
Total Truck	66,527	11,217	0.17	63,803	0.96	66,811	1.00
Total Traffic	1,364,000	1,370,773	1.00	1,394,645	1.02	1,398,151	1.03
Truck/Total Traffic	4.9%	0.8%		4.6%		4.8%	
I-880							
Small Truck, 2-axle	34,146	-	-	22,720	0.67	22,513	0.66
Medium Truck, 3-axle	11,727	-	-	4,531	0.39	10,991	0.94
Large Truck, 4-axle +	43,912	11,207	0.26	30,671	0.70	41,177	0.94
Total Truck	89,785	11,207	0.12	57,922	0.65	74,680	0.83
Total Traffic	1,274,000	1,090,621	0.86	1,116,197	0.88	1,121,084	0.88
Truck/Total Traffic	7.0%	1.0%		5.2%		6.7%	
I-80							
Small Truck, 2-axle	14,316	-	-	20,219	1.41	19,956	1.39
Medium Truck, 3-axle	3,422	-	-	3,896	1.14	6,715	1.96
Large Truck, 4-axle +	25,120	6,299	0.25	24,556	0.98	26,030	1.04
Total Truck	42,858	6,299	0.15	48,670	1.14	52,700	1.23
Total Traffic	924,000	892,283	0.97	887,893	0.96	885,232	0.96
Truck/Total Traffic	4.6%	0.7%		5.5%		6.0%	
I-580							
Small Truck, 2-axle	6,269	-	-	12,349	1.97	12,332	1.97
Medium Truck, 3-axle	1,606	-	-	1,734	1.08	2,399	1.49
Large Truck, 4-axle +	12,592	2,156	0.17	12,352	0.98	12,661	1.01
Total Truck	20,467	2,156	0.11	26,434	1.29	27,392	1.34
Total Traffic	477,000	466,494	0.98	482,975	1.01	483,632	1.01
Truck/Total Traffic	4.3%	0.5%		5.5%		5.7%	
I-680							
Small Truck, 2-axle	20,773	-	-	24,405	1.17	24,419	1.18
Medium Truck, 3-axle	4,176	-	-	3,961	0.95	5,739	1.37
Large Truck, 4-axle +	20,748	7,471	0.36	18,592	0.90	18,447	0.89
Total Truck	45,697	7,471	0.16	46,958	1.03	48,605	1.06
Total Traffic	784,000	874,542	1.12	890,548	1.14	890,524	1.14
Truck/Total Traffic	5.8%	0.9%		5.3%		5.5%	
Overall							
Small Truck, 2-axle	111,418	-	-	113,168	1.09	112,791	1.01
Medium Truck, 3-axle	27,532	-	-	17,797	0.72	32,556	1.18
Large Truck, 4-axle +	126,384	38,350	0.34	112,822	0.99	124,842	0.99
Total Truck	265,334	-	-	243,787	1.01	270,189	1.02
Total Traffic	4,823,000	4,694,713	1.02	4,772,259	1.04	4,778,622	0.99
Truck/Total Traffic	5.5%	0.8%		5.1%		5.7%	

← Low in I-880

← High in I-80

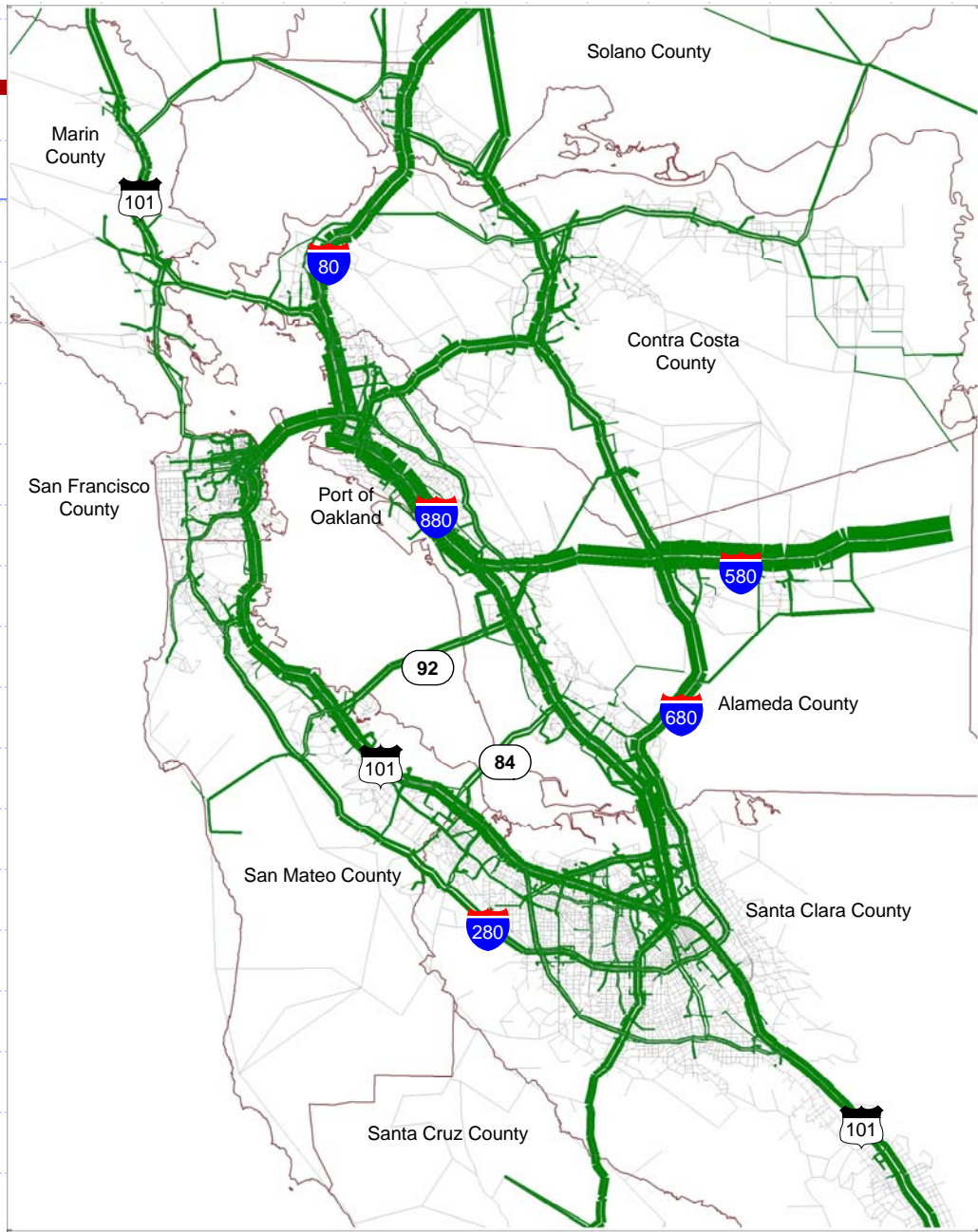
← High in I-580



Analysis of Selected Highway Corridors

- Daily Truck Model Volumes in Bay Area





Conclusions

- A state-of-the-practice truck demand model was developed and can be used for countywide transportation projects that are impacted by heavy truck traffic for the Bay Area.
- Truck traffic volumes and total traffic volumes in the model were validated to both truck traffic and total traffic counts from Caltrans and PEMS.
- The validation results show that the improved truck model explains truck volumes as well as total traffic volumes with significantly higher performance than the previous truck model.
- Future extensions of the present work might consider the addition of more special truck generators in the East Bay area along the I-880 corridor.
- It is recommended that a new method to derive the truck trip rates for ports, airports, and specific heavy industrial facilities and distribution business be developed through more truck research and detailed trip generation studies.
- Truck trip distribution patterns should also be developed based on collecting data on observed travel patterns.



Questions & Comments?

