Chapter 15 HEAVY DUTY TRUCK MODEL

INTRODUCTION

This Chapter addresses the various elements of the Heavy Duty Truck (HDT) Model, including internal and external HDT trips, Port HDT trips and Intermodal HDT trips. Included is a description of the model inputs, an overview of the various model components, and a summary of the 2019 HDT Model results[1].

HDT MODEL STRUCTURE

Figure 15-1 provides a flow chart of the overall structure of the HDT model. The model forecasts trips for three HDT weight classes: light-heavy (8,500 to 14,000 lbs. gross vehicle weight (GVW); medium-heavy (14,001 to 33,000 lbs. GVW); and heavy-heavy (>33,000 lbs. GVW). The key components of the new HDT Model are the following:

> ***External Trip Generation and Distribution Model.*** This component estimates the trip table for all interregional truck trips that link Southern California with the rest of the nation. The updated external HDT model is based on variations of disaggregate supply chain models to better represent differences in the movements of each commodity and the linkage to industries within the SCAG region. The updated model is covering trucks origins and destinations outside the

1 Cambridge Systematics, Inc., *SCAG Task 4 Data Verification and Analysis – Final Report*, October 2010.

model region. The distribution of external flows are finally calibrated using sample of GPS probe data from year 2019.

Internal Trip Generation and Distribution Models. This component of the HDT Model estimates trip tables for intraregional trips. Trip generation is based on trip rates (number of trips per employee or household) for different land uses/industry sectors at the trip ends. The trip rates derived from establishment surveys, Transearch data and GPS data.

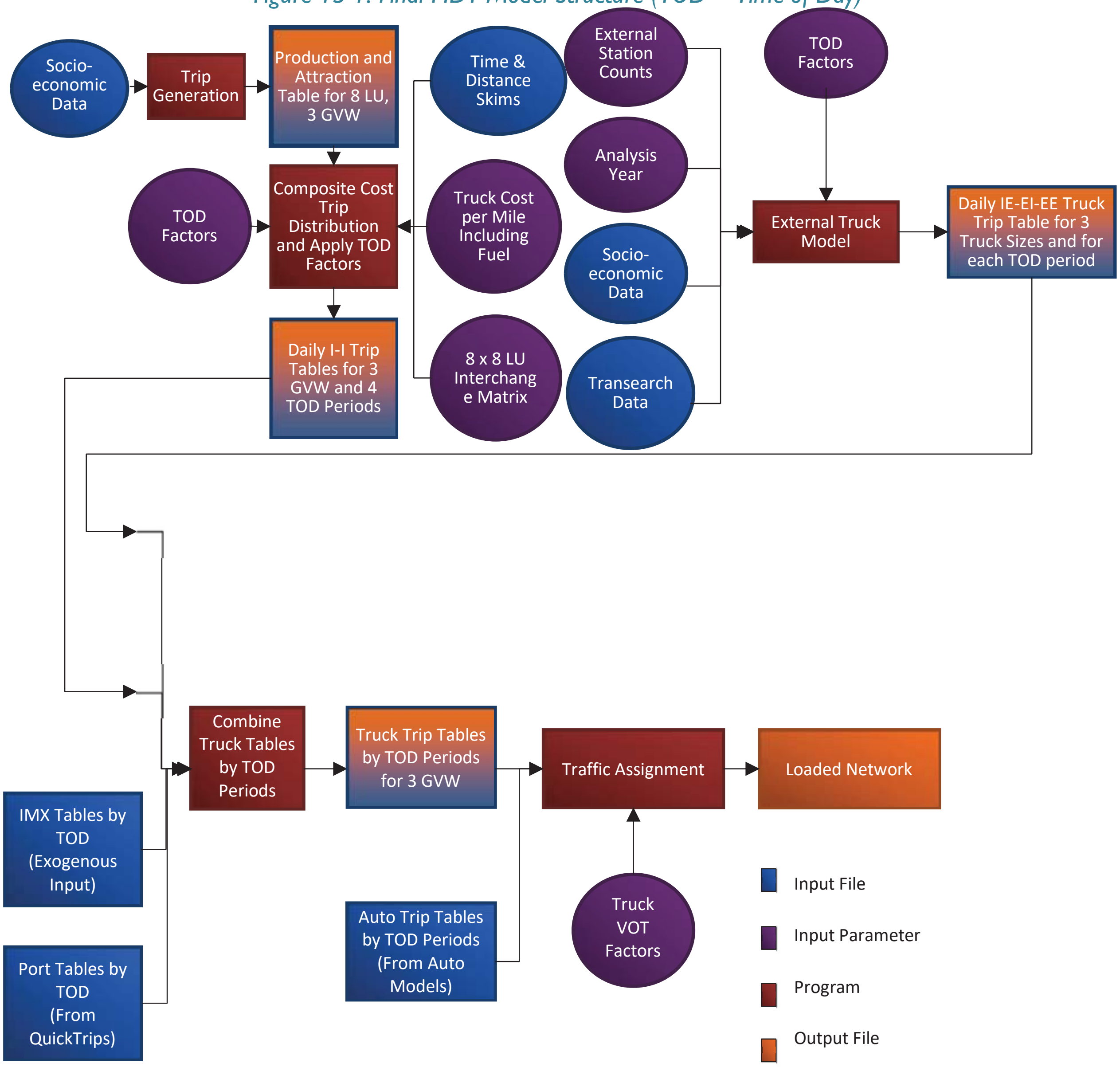
The trip distribution process was originally developed in 2008 by developing a matrix of factors that indicate the trip interchange relationships among different land use types (i.e., what fraction of trips originating at a land use such as manufacturing sites go to warehouses vs. other manufacturing sites, etc.). The GPS survey data was used to develop a series of gravity models for each truck class. This offers some of the benefits of tour-based models by directing trips from zone to zone based on logical relationships amongst land use types without the extensive data requirements (typically difficult to collect from trip diary surveys) that are required to support development of a full tour-based model. The original factors are further calibrated using recent 2019 GPS data.

Special Generator Trip Generation and Distribution Models. These models include the port model and the intermodal rail model. All of the input parameters to the port trip generation model were updated to reflect current port capacity improvements and throughput forecasts. This model update also implements a procedure to incorporate two types of secondary port truck trips. Transload secondary trips are cargo trips from intermediate handling locations (i.e., transloading sites where cargo is moved from international to domestic containers) to final destinations. Additionally, there are secondary repositioning movements of trucks associated with port truck trips. These movements include trips made by trucks that originated at a port but do not immediately return to a port. Similarly, secondary repositioning movements also include trips that travel to a location from a non-port zone prior to traveling to a port. Secondary transload trips are distributed by the port model using a combination of a gravity model and an intermodal railyard model. Secondary repositioning trips are allocated to other zones in the region using the gravity model distribution.

Trip Assignment. The model incorporates a multiclass assignment combining the truck trip tables with the passenger trip tables. Prior to assignment, the truck trip tables are converted to PCEs. The PCE factors were adapted from the Transportation Research Board (TRB) Highway Capacity Manual2 (HCM), and are a function of the percent truck volume and length and steepness of grades. Five time periods are used to assign truck trips, consistent with the auto trip assignment. Updated time-of-day factors were developed using data from permanent classification count stations, weigh-in-motion (WIM), and vehicle classification counts.

2 Highway Capacity Manual. Volume 2: Uninterrupted Flow. Transportation Research Board: Washington D.C., 2010.

Figure 15-1: Final HDT Model Structure (TOD = Time-of-Day)



Internal HDT Model

Internal HDT Trip Generation Model

The internal truck trip generation model is land use-based, where trip rates are multiplied by employment by industry sector to obtain internal truck trip productions and attractions. All the internal truck travel in the region is associated with ten broad but distinct land uses, namely, households, agriculture, mining/construction, retail, manufacturing, transportation, wholesale, general warehousing, high cube warehousing, and other (service). The trip rates (i.e., truck trips per employee) were updated based on 2019 Transearch data and third-party truck GPS data. Trip rates for general warehousing and high cube warehousing were updated using a combination of establishment surveys and independent trip generation studies.

Land Use and Socioeconomic Data

The socioeconomic data used by the Internal HDT Model is consistent with those data used by the passenger model, except that the employment data are stratified into more employment categories. The 22 two-digit NAICS categories of employment were mapped to 9 categories to account for truck trip generation similarities. This employment category mapping is shown in Table 15-1. These stratified employment types, plus households, support ten land use purposes for the HDT trip generation models: Households, Agriculture, Mining/Construction, Retail, Governments, Manufacturing, Transportation, General Warehousing, High Cube Warehousing, Wholesale, and Other (service). The warehousing land use categories were separated from the transportation and utility category using data from secondary establishment surveys and warehousing studies.

Table 15-1: Aggregated Two-Digit NAICS Categories

Survey Number	Two-Digit	Two-Digit Description	ABM number	Aggregate Categories for Trip Generation Mode
1	11	Agriculture, Forestry, Fishing, and Hunting	1	Agriculture, Forestry, Fishing, and Hunting
2	21	Mining	2	Mining/Construction
3	22	Utilities	9	Other
4	23	Construction	2	Mining/Construction
5	31	Manufacturing	4	Manufacturing
6	42	Wholesale Trade	6	Wholesale Trade
7	44	Retail Trade	3	Retail Trade
8	45	Retail Trade	3	Retail Trade

Survey Number	Two-Digit	Two-Digit Description	ABM number	Aggregate Categories for Trip Generation Mode
9	48	Transportation and Warehousing	5	Transportation and Warehousing
10	49	Transportation and Warehousing	5	Transportation and Warehousing
11	51	Information Services	9	Other
12	52	Finance and Insurance	9	Other
13	53	Real Estates, and Rental and Leasing	9	Other
14	54	Professional, Scientific, and Technical Services	9	Other
15	55	Management of Companies and Enterprises	9	Other
16	56	Administrative and Support, and Waste Management and Remediation Services	9	Other
17	61	Educational Services	9	Other
18	62	Health Care, and Social Assistance	9	Other
19	71	Arts, Entertainment, and Recreation	9	Other
20	72	Accommodation, and Food Services	9	Other
21	81	Other Services (Except Public Administration)	9	Other

Internal HDT Trip Rates

Trip rates derived from TRANSEARCH data, and GPS data for each truck type. The TRANSEARCH data are provided as annual county level flows in tons and are converted to daily weekday flows using an annualization factor of 306 (6 days per week for 51 weeks) for all commodities. The county flows were disaggregated to RSAs using economic-input-output relationships. 43 commodities in TRANSEARCH data were aggregated to 3 commodity groups and then flows are converted from tons to trucks using the payload factors shown in Table 15-2. These payload factors were developed using data from the 2018 California Vehicle Inventory and Use Survey (VIUS).

Table 15-2: Internal HDT Commodity Payload Factors

SCTG	Commodity Name	Commodity Group	Payload (ton)
1	Animals and Fish (live)		21.72
2	Cereal Grains		28.43

SCTG	Commodity Name	Commodity Group	Payload (ton)
3	Agricultural Products	Agricultural & Bulk natural resource (AGBNR)	22.19
10	Monumental or Building Stone		26.69
11	Natural Sands		29.78
12	Gravel and Crushed Stone		32.96
13	Other Non-Metallic Minerals NEC		31.56
14	Metallic Ores and Concentrates		31
15	Coal		34.95
16	Crude Petroleum		24.01
19	Other Coal and Petroleum Products NEC		20.01
25	Logs and Other Wood in the Rough		25.77
5	Meat, Poultry, Fish, Seafood	Finished goods (FG)	15.72
6	Milled Grain Products and Preparations		9.37
7	Other Prepared Foodstuffs, Fats and Oils		17.81
8	Alcoholic Beverages and Denatured Alcohol		18.69
9	Tobacco Products		11.29
21	Pharmaceutical Products		14.41
29	Printed Products		10.26
30	Textiles, Leather, and Articles of		12.38
31	Non-Metallic Mineral Products		31.39
34	Machinery		16.76
35	Electronic and Other Electrical Equipment		13.14
36	Motorized and Other Vehicles (includes parts)		17.43
37	Transportation Equipment NEC		23.54
38	Precision Instruments and Apparatus		9.49
39	Furniture, Mattresses and Mattress Supports, etc.		14.17
40	Miscellaneous Manufactured Products		14.84
43	Mixed Freight		26.53
99	Commodity unknown		20.57
4	Animal Feed, Eggs, Honey, and Other	Intermediate processed goods (IPG)	22.92
17	Gasoline, Aviation Turbine Fuel, and Ethanol		21.11
18	Fuel Oils (includes Diesel, Bunker C, and Biodiesel)		27.88

SCTG	Commodity Name	Commodity Group	Payload (ton)
20	Basic Chemicals		21.79
22	Fertilizers		23.79
23	Other Chemical Products and Preparations		20.05
24	Plastics and Rubber		14.26
26	Wood Products		19.5
27	Pulp, Newsprint, Paper, and Paperboard		21.81
28	Paper or Paperboard Articles		11.04
32	Base Metal in Primary or Semi-Finished Forms		15.1
33	Articles of Base Metal		15.07
41	Waste and Scrap		23.44

Note: SCTG – Standard Classification of Transported Goods

Linear regression equations were developed to estimate trips generated by TAZs. Transearch flows are based on tonnages of goods traded between regions, therefore it does not cover all truck movements. Truck movements related to last mile delivery, empty trucks, municipality services, landscaping, maintenance, etc. are not part of Transearch data set.

To have complete representation of truck movements in the model, a sample of truck GPS OD flows between TAZs were expanded using more than 7000+ count locations across SCAG regions. The classified truck counts were developed using HPMS and Caltrans traffic count data. The Transcad Origin-Destination Matrix Estimations (ODME) procedure was used to expand the sample flows to match traffic counts. The GPS sample data was classified by autos, medium trucks (14,001 to 26,000 lbs. GVWR); and heavy trucks (>26,000 lbs. GVWR). Using California VIUS data it is estimated that 18.4% of trucks with GVWR greater than 26,000 lbs. are in HHDT class (with GVWR greater than 33,000 lbs).

The truck count data were presented based on FHWA axel classification. To map the truck counts data to HDT model truck classes, a cross walk was developed as shown in Table 15-3.

Table 15-3: FHWA 13-Class to HDT Trucks Crosswalk

FHWA /SCAG	LHDT	MHDT	HHDT	Sum
3	81.4%	18.3%	0.3%	100%
5	34.2%	64.0%	1.8%	100%
6	3.2%	25.3%	71.5%	100%
7	0.0%	3.0%	97.0%	100%
8	27.6%	4.7%	67.7%	100%
9	0.1%	2.5%	97.4%	100%

10	9.1%	2.2%	88.7%	100%
11	0.0%	5.1%	94.9%	100%
12	0.0%	0.0%	100.0%	100%
13	0.0%	0.0%	100.0%	100%

This expanded matrix was used as a control total for all truck trips. Truck trips from Transearch was estimated to be about 8% of total trips. Regression equations are developed for non-Transearch truck trips by vehicle class. The initial trip rates were later calibrated based on model traffic assignment results compared with screenlines. All rates are defined as employee per land use category or number of households and shown in Table 15-4.

Table 15-4: Internal HDT Trip Rates per employees / Households

Category	Light HDT Trip Rate	Medium HDT Trip Rate	Heavy HDT Trip Rate
Households	0.0767	0.0126	0.0009
Agriculture	0.0020	0.0019	0.0018
Mining/Construction	0.0095	0.0092	0.0085
Retail	0.0594	0.0446	0.0446
Manufacturing	0.0273	0.0291	0.0412
Transportation	0.0353	0.0406	0.0716
Wholesale	0.0940	0.0994	0.1351
General Warehousing(Employment)	0.2670	0.1780	0.4450
High Cube Warehousing (Employment)	0.2828	0.1414	0.2828
Other	0.0186	0.0062	0.0062

Table 15-5 shows the 2019 HDT trip generation estimates. As expected, households in the region generate a high number of trip ends, especially for Light HDT. This is mostly due to the fact that land uses such as transportation and warehousing, utilities, service and retail deliver goods and provide services to residential neighborhoods. The largest HDT trip generator is the transportation and utility land use that includes trucks involved in power generation, water supply and sewage treatment, all kinds of transportation (trucking industry, taxi, and chartered services), and postal and courier services. The second highest generators of HDT trips are retail and manufacturing land uses, which account for a major share of employment in the region and serve the vast area and population of the six-county SCAG region.

Table 15-5: 2019 Internal HDT Trip Generation Estimates

Land Use	Light HDT Trip Ends	Medium HDT Trip Ends	Heavy HDT Trip Ends	Total Trip Ends	Percent of Total Trip Ends
Households	475,005	78,032	5,574	558,610	43%
Mining/Construction	4,981	4,823	4,456	14,261	1%
Retail	50,136	37,644	37,644	125,423	10%
Agriculture	124	118	112	353	0%
Manufacturing	19,751	21,053	29,807	70,610	5%

Land Use	Light HDT Trip Ends	Medium HDT Trip Ends	Heavy HDT Trip Ends	Total Trip Ends	Percent of Total Trip Ends
Transportation	16,866	19,399	34,210	70,475	5%
Wholesale	41,626	44,018	59,827	145,471	11%
Other	106,616	35,539	35,539	177,694	14%
General Warehousing	27,625	18,417	46,042	92,085	7%
High Cube Warehousing	18,709	9,355	18,709	46,774	4%
Total	761,439	268,397	271,920	1,301,756	100%

Internal HDT Trip Distribution Model

The trip distribution process was modified by developing a matrix of factors that indicate the trip interchange relationships among different land use types (i.e., what fraction of trips originating at a land use such as manufacturing sites go to warehouses vs. other manufacturing sites, etc.). The internal HDT trip distribution model uses a gravity formulation, stratified by land use type at both the production and the attraction end of the trip. This results in a total of 100 gravity models for each truck type: Light-Heavy Duty Truck (LHDT), Medium-Heavy Duty Truck (MHDT) and Heavy-Heavy Duty Truck (HHDT). After trip distribution, the 100 different trip matrices are combined into a single matrix for each truck type, so that only three matrices are passed on to time-of-day factoring and trip assignment.

Truck trips are distributed using composite cost impedances that account for time and distance-based monetary costs in addition to travel time. Based on a review of the literature, the appropriate distance-based costs for the SCAG model are identified in a report commissioned by the Minnesota Department of Transportation (DOT)3. These costs account for fuel, tires, maintenance and repair, and depreciation.

The link composite cost is calculated as shown in the equation below. The corresponding unit costs are shown in Table 15-6.

*Composite Cost = Cost per hour * Congested time + [Fuel Price / Fuel efficiency + Cost per mile (excluding fuel)] * Distance*

Table 15-6: Composite Truck Unit Costs

Truck Type	Cost per Hour	Fuel Efficiency (MPG)	Cost per Mile (excluding fuel)	Fuel Price per Gallon (a)
LHDT	$28.62	14.40	$0.29	$3.18
MHDT	$32.55	8.80	$0.55	$3.31 (b)
HHDT	$32.55	5.80	$0.62	$3.31 (b)

3 Levinson, David Matthew, Corbett, Michael J. and Hashami, Maryam, *Operating Costs for Trucks*, (2005) http://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID1736159_code807532.pdf?abstractid=1736159&mirid=1.

(a) Assumes all MHDT and HHDT trucks are diesel a fleet mix of 62% gasoline and 38% diesel powered trucks for LHDT.
(b) Fuel prices based on average 2019 California gasoline and diesel prices.

The GPS survey of truck trips provided the data to calibrate the model friction factors. These data were used to build observed truck trip flow matrices, stratified by truck type (MHDT and HHDT). The TransCAD gravity model calibration utility was used to calibrate the friction factors that best matched the observed truck flow matrices, given the composite cost impedances and land-use based trip productions and attractions. The 2019 sample GPS data did not include LHDT, therefore older data was used for model calibration. Figures 15-1 to 15-3 show the trip length calibration performed for the 2019 HDT model update, respectively for each truck class. Calibrated model parameters have been retained in the 2019 base year model.

Figure 15-2: LHDT Internal Truck Trip Length Calibration

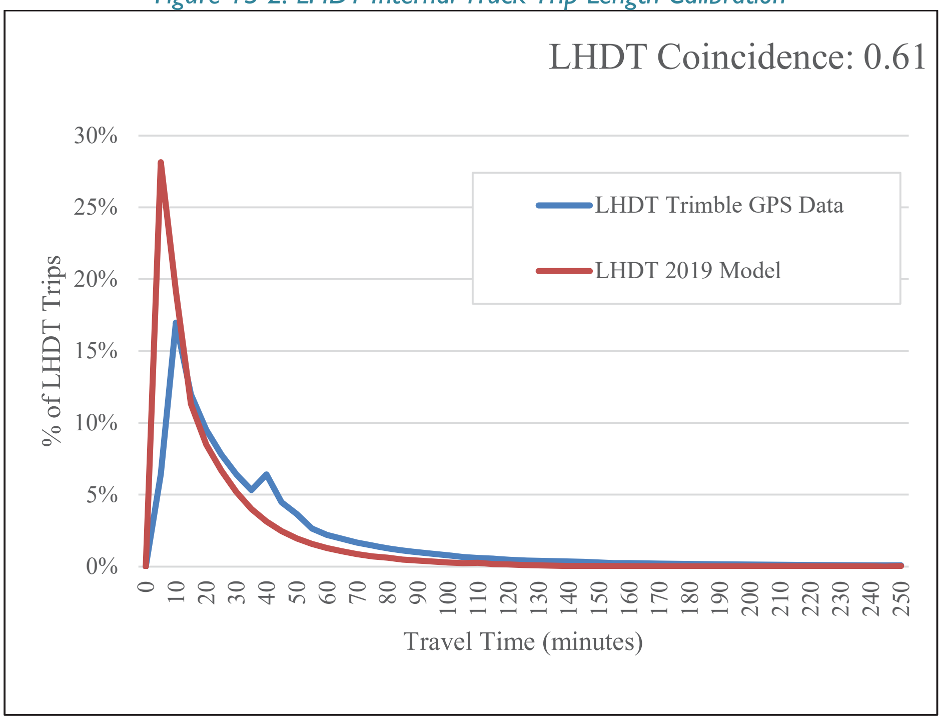


Figure 15-3: MHDT Internal Truck Trip Length Calibration

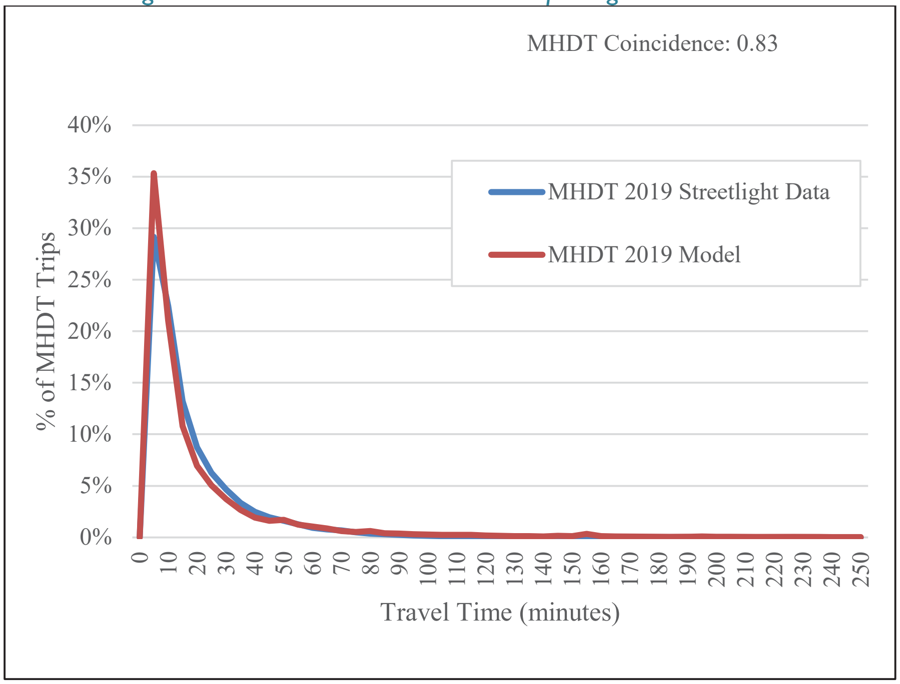
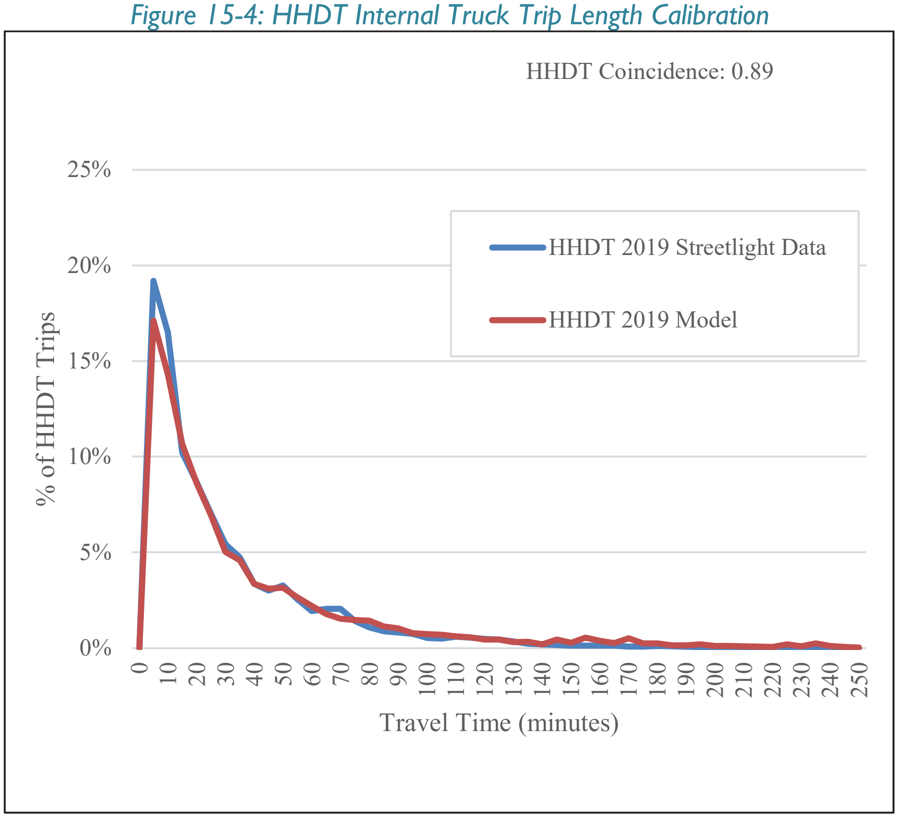


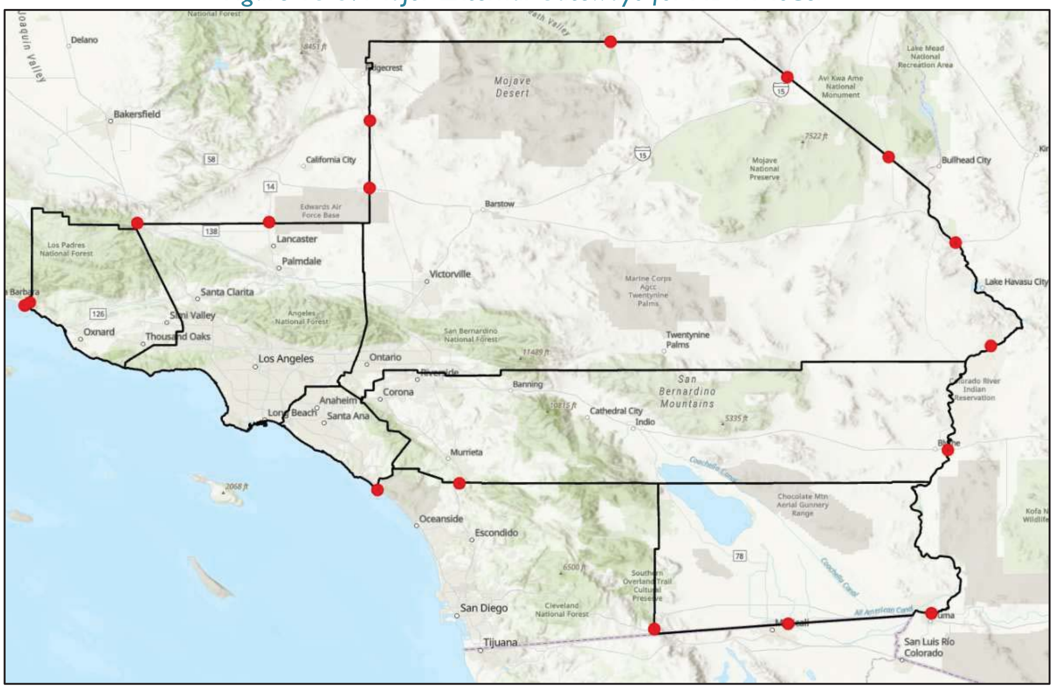
Figure 15-4: HHDT Internal Truck Trip Length Calibration



EXTERNAL HDT MODEL

The external HDT Model consists of internal-external and external-internal truck trips, and external-external (EE) truck trips. The model has 40 external gateways of those 17 of them carry over 90% of total external traffic. The daily traffic volume by vehicle class at these 17 gateways of SCAG region were estimated using GPS sample data.

Figure 15-5: Major External Gateways for HDT Model



The IE/EI HDT trips are generated and distributed using a combination of Transearch commodity flow data at the county level and GPS data for distribution to RSAs and later to TAZs.

The external HDT Model is based on the 2019 TRANSEARCH commodity flow table. The TRANSEARCH data are provided as annual flows in tons and are converted to daily weekday flows using an annualization factor of 306 (6 days per week for 51 weeks) for all commodities. The flows are converted from tons to trucks using the payload factors shown in Table 152. These payload factors were developed using data from the 2018 Vehicle Inventory and Use Survey (VIUS).

However, the TRANSEARCH flows for IE/EI flows were much smaller than the sum of medium and heavy truck volumes at the major gateways. Therefore, the matrix has to be calibrated to represent the conditions on the ground.

The distribution of flows within RSAs at each county was developed based on a sample of GPS data. for this purpose, the GPS probe data was processed with various assumptions:

A truck trip starts or ends when the vehicle is not moving for at least 5 min.

A truck trip starts or ends when the vehicle is not moving for at least 90 min.

A truck trip starts or ends when the vehicle is not moving for at least 120 min.

The 5 min processed data was significantly different from the 90 min and 120 min data sets. The 90 min and 120 min datasets were showing fairly close patterns. The 90 min data set was used as starting point. For TAZs with a major Intermodal facility such as UP rail yard at Colton or Ontario the distribution were further calibrated based on screen line counts and overall VMT targets by each region.

External – External HDT Trips

The 2019 TRANSEARCH data identify EE truck freight flows passing through the SCAG region. To assign the cordon station to each EE trip end, a method similar to the one used for the external end of the IE/EI trips was used.

Table 15-7: 2019 Daily Truck Volume at major External Gateways

Node ID	Description	Medium HDT	Heavy HDT
4110	CA-101 @ Ventura| Santa Barbara County borderline	3,241	2,237
4111	Near 101- Ventura	202	47
4130	CA-95@ Nevada border line	275	413
4128	I-15 @ Nevada border line	2,086	6,243
4134	CA-62 @ Arizona borderline	417	336
4132	I-40 @ Arizona borderline	1,283	6,892
4136	I-8 @ Arizona borderline	804	2,898
4135	I-10 @ Arizona borderline	895	9,236
4125	CA-127 @ San Bernardino | Inyo County borderline	85	73
4117	CA-14 @ Los Angeles | Kern borderline	1,901	1,509
4114	I-5 @ Los Angeles | Kern borderline	4,196	10,802
4121	CA-58 @ San Bernardino | Kern County borderline	1,297	4,359
4122	CA-395 @ San Bernardino | Kern County borderline	362	873
4140	I-8 @ Imperial County | San Diego borderline	902	1,395
4145	I-15 @ Riverside | San Diego County border line	6,676	4,740
4149	I-5 @ Orange | San Diego County border line	6,254	3,421
4138	CA-7 @ Mexico borderline	483	432
	Sum	**31,359**	**55,906**

PORT HDT MODEL

Ports TAZ Development

The SCAG Tier 1 Zone System consists of 4,192 TAZs, including 42 TAZs that represent the Ports areas. The Port HDT Model was updated to use a more refined set of port TAZs, developed by the Ports of Los Angeles and Long Beach. This zone system, called Port Transportation Analysis Model (Port TAM), includes a total of 90 Port area TAZs, for a total of 4,253 Tier 1 TAZs. Table 15-8 below provides a summary breakdown of the 4,253 TAZ system.

Table 15-8: Port TAM 4,253 TAZ System

from Zone ID	To Zone ID	Zone Type	Total
1	4109	Internal zones	4,109
4110	4149	External zones	40
4150	4161	Airport zones	12
4162	4251	Port zones	90
4251	4253	Extra zones	2
Total Zones			**4,253**

Port Truck Trip Generation

The port trip generation model was developed on a detailed port area zone system and specialized trip generation rates for autos and trucks by type (Bobtail, Chassis, and Containers). Port truck trip generation has two components: 1) container terminal truck trips, and 2) non-container terminal truck trips.

Container Terminal Truck Trip Generation

The container terminal truck trip generation model for the ports is referred to as the QuickTrip Model. QuickTrip was originally developed for the Ports of Los Angeles and Long Beach. The Model includes detailed input variables such as mode split (rail versus truck moves), time-of-day factoring, weekend moves, empty return factors, and other characteristics that affect the number of trucks entering and exiting through the terminal gates. The relevant input data for each container terminal include the following:

Peak monthly Twenty-Foot Equivalent Units (TEU) throughput.

TEU-to-lift conversion factor: factor determining the average number of TEUs associated with each lift at the terminal.

TEU land-side throughput distributions: percent of TEU throughput associated with on-dock intermodal imports, on-dock intermodal exports, off-dock intermodal imports, off-dock intermodal exports, local imports, local exports, empties, and trans-shipments across the wharf.

Number of operating days during the week.

Percent of throughput moved during each terminal operating shift (for the day, second and hoot shifts).

QuickTrip produces the following truck trip outputs for each terminal:

Monthly gate transactions

Peak week truck trip volume

Daily truck trips, and truck trips by each hour of the day by type of truck trip (bobtail, chassis, container, empty), and direction (arrival at and departure from the terminal)

QuickTrip can be used to generate base as well as future year truck trips by truck type and direction for each terminal, using the model inputs described earlier for each specific year. The inputs that are particularly expected to change for different years include the peak monthly TEU throughput, and the TEU land-side throughput distributions (based on expected increase in on-dock intermodal capacity at the port terminals in the future). Additionally, the model has the capability to analyze the impacts of other port truck trip reduction strategies such as virtual container yards and off-peak truck diversions, using specific inputs associated with these strategies.

The Model was enhanced to allow the user to assess whether the estimated capacity of each rail yard has been exceeded. If so, traffic is iteratively re-allocated to other yards that are not over capacity. The enhanced model also allows the user to choose different efficiency factors, such as "percent double cycle trucks," for different off-dock yards. In the original version, the user had to use the same variables for the entire off-dock market.

Non-Container Terminal Truck Trip Generation

Non-container terminal truck trip generation estimates were also developed for the Ports as part of the Port truck trip generation process. This includes trips to and from all of the other types of marine terminals (automobile terminals, dry bulk terminals, liquid bulk terminals and break-bulk terminals). In addition, there are many non-terminal land uses located throughout the ports (e.g., administrative offices, recreation, commercial, government buildings) that potentially generate truck traffic.

Existing non-container terminal truck trips were developed by conducting a series of driveway and midblock truck counts throughout the Ports. A number of specific terminals were counted at their driveways, while other terminals and miscellaneous land use activities were reflected via the use of downstream roadway truck counts. In some cases, a roadway truck count was used to represent the trip generation of a group of non-container terminals and other land uses.

Port Trip Table Distribution

The zone-to-zone distribution of port truck trips is based on a fixed OD matrix. A detailed and comprehensive truck driver survey was undertaken by the ports at the marine container terminals. The survey was used to develop detailed origin-destination trip tables for use in the Port area travel demand model. The stated trip OD from every valid survey was correlated with the travel demand model TAZ system. The survey results were then used to develop port truck OD frequency distributions by truck type for use in the model. Distribution patterns were developed separately for arrival trips and departure trips for each terminal. A total of 15 Port Truck Trip Tables were developed (5 time periods by 3 vehicle classes): AM, MD, PM, EV and NT time periods, and Bobtails, Chassis and Container truck trips. The time periods are consistent with those used by the passenger model, but combine the night and evening periods into a single night time period. Empty container and loaded container truck types are combined into one truck type called container truck type.

For terminals with few or no observations (Pier C, YTI and APL) an average distribution of all surveyed records was used. Before creating survey frequency distribution vectors, survey sample trips were adjusted to exclude trips that have both OD within the same terminal.

Base Year Port Trip Tables Summary

Summaries of 2019 Port truck trips are shown in Table 15-9 and Table 15-10.

Table 15-9: 2019 Port HDT Trips by Truck Type

Time Period	Bobtails	Chassis	Containers	Total
AM	1,710	560	3,011	5,281
MD	8,750	2,345	15,391	26,487
PM	4,166	1,019	7,058	12,243
EV	2,003	515	3,551	6,068
NT	4,093	1,052	7,255	12,401
Daily	20,723	5,491	36,266	62,480

Table 15-10: 2019 Port HDT Trips by Time Period and County

County	Time Period					
	AM	**MD**	**PM**	**EV**	**NT**	**Total**
Imperial	0	0	0	0	0	0
Los Angeles	4,980	25,216	11,679	5,763	11,777	59,414
Orange	25	106	47	26	53	257
Riverside	132	558	247	133	273	1,343
San Bernardino	135	569	253	137	280	1,373
Ventura	0	0	0	0	0	0
External Stations	9	38	17	9	19	92
Total	5,281	26,487	12,243	6,068	12,401	62,480
% of Daily Trips	8.45%	42.39%	19.59%	9.71%	19.85%	

Intermodal HDT Trips

Intermodal Trips and Secondary Transload HDT Trips

Intermodal (IMX) trucks trips are heavy HDT movements generated at the six regional intermodal facilities in the SCAG region. These intermodal facilities are shown in Figure 15-5. In addition to trips to and from the Ports and intermodal railyards, the PortTAM model accounts for secondary trips associated with transloading of container cargo. Transloading occurs when cargo in 20- and 40-foot international containers is moved to larger (usually 53-foot) domestic containers. The loaded domestic containers are drayed to intermodal railyards, trucked to other warehouse or wholesale locations, or trucked outside of the SCAG region.

A summary of these truck movements is shown in Table 15-11 These truck trips were all assumed to be HHDTs. The daily truck trips were developed assuming an annualization factor of 306.

Figure 15-6: Intermodal Facilities in the SCAG Region

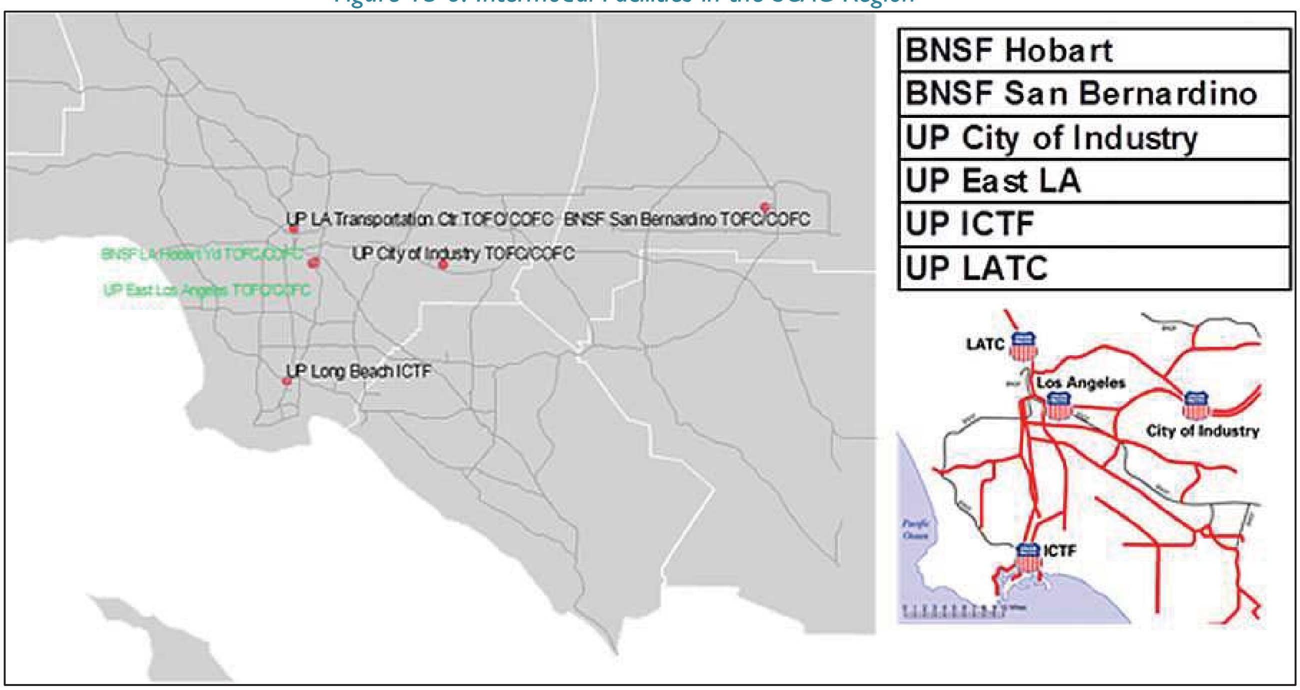


Table 15-11: 2019 Intermodal trips and secondary transload trips by County

	Imp	LA	Ora	Riv	SBD	Ven	Total
Intermodal (IMX)	9	5567	373	295	1920	63	8,228
Secondary	2	7270	189	325	1205	25	9,015
Total	11	12838	561	620	3125	88	17,242

HDT Time-of-Day Factoring & Assignment

The HDT Model uses fixed time-of-day factors derived from observed truck counts. The HDT time of time periods are consistent with the passenger model periods, namely:

AM Peak: 6:00 AM – 9:00 AM

Mid-day: 9:00 AM - 3:00 PM

PM Peak: 3:00 PM - 7:00 PM

Evening: 7:00 PM – 9:00 PM

Night: 9:00 PM – 6:00 AM

The HDT diurnal factors were derived from the 2007 Vehicle Travel Information System (VTRIS)4 database. VTRIS is maintained by the FHWA Office of Highway Policy Information to track traffic trends, vehicle distributions and weight of vehicles to meet data needs specified in highway legislation. The VTRIS database contains truck classification counts spanning nearly half a year at many locations on SCAG interstate and state highways. The HDT time of day factors are shown in Table 15-12.

Table 15-12: HDT Time-of-Day Factors

Time Period	Diurnal Factors		
	LHDT	**MHDT**	**HHDT**
AM Peak (6 AM - 9AM)	18.8%	18.0%	13.9%
Midday (9 AM-3PM)	42.9%	46.5%	35.3%
PM Peak (3 PM- 7PM)	20.3%	15.5%	16.7%
Evening (7 PM - 9 PM)	4.8%	3.5%	7.2%
Night (9 PM - 6AM)	13.2%	16.5%	26.9%

HDT trips are assigned simultaneously with the auto trips as part of a user equilibrium multiclass assignment. The assignment methodology is described in detail in Chapter 16– Trip Assignment. Truck volumes are converted to PCEs following the procedures recommended in the 2010 Highway Capacity Manual. The PCE factors are a function of grade, length of the climb segment, and percent of truck volume, and vary by truck type (LHDT, MHDT and HHDT). These factors are shown in Table 15-13.

4 http://www.fhwa.dot.gov/ohim/ohimvtis.cfm

Table 15-13: HDT Passenger Car Equivalent Factors

Percent Trucks	Length of Grade in miles	Light -Heavy				Medium-Heavy				Heavy-Heavy			
		% Grade				% Grade				% Grade			
		< 2	2 - 4	4 - 6	> 6	< 2	2 - 4	4 - 6	> 6	< 2	2 - 4	4 - 6	> 6
0-5%	< 1	1.3	1.5	3.0	4.0	1.5	2.0	3.5	5.0	2.5	2.5	4.5	6.0
	1 - 2	1.3	2.5	4.0	5.0	1.5	3.5	5.0	6.5	2.5	5.0	7.5	12.5
	> 2	1.3	2.5	4.0	5.0	1.5	3.5	5.0	6.5	2.5	5.0	7.5	12.5
5-10%	< 1	1.3	1.5	2.5	3.0	1.5	2.0	3.0	4.0	2.5	2.5	4.5	5.5
	1 - 2	1.3	2.0	3.5	4.0	1.5	3.0	4.0	5.5	2.5	4.0	8.0	11.5
	> 2	1.3	2.0	3.5	4.0	1.5	3.0	4.0	5.5	2.5	4.0	8.0	11.5
>10%	< 1	1.3	1.5	2.0	2.5	1.5	2.0	2.5	3.0	2.5	2.5	4.0	4.0
	1 - 2	1.3	2.0	3.0	3.5	1.5	2.5	3.5	4.0	2.5	3.5	6.0	9.0
	> 2	1.3	2.0	3.0	3.5	1.5	2.5	3.5	4.0	2.5	3.5	6.0	9.0