

# Orange County Travel Model Update

*presented to*  
NYSAMPO Modeling Working Group

*presented by*  
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October 29, 2021

Think  Forward

# Objectives

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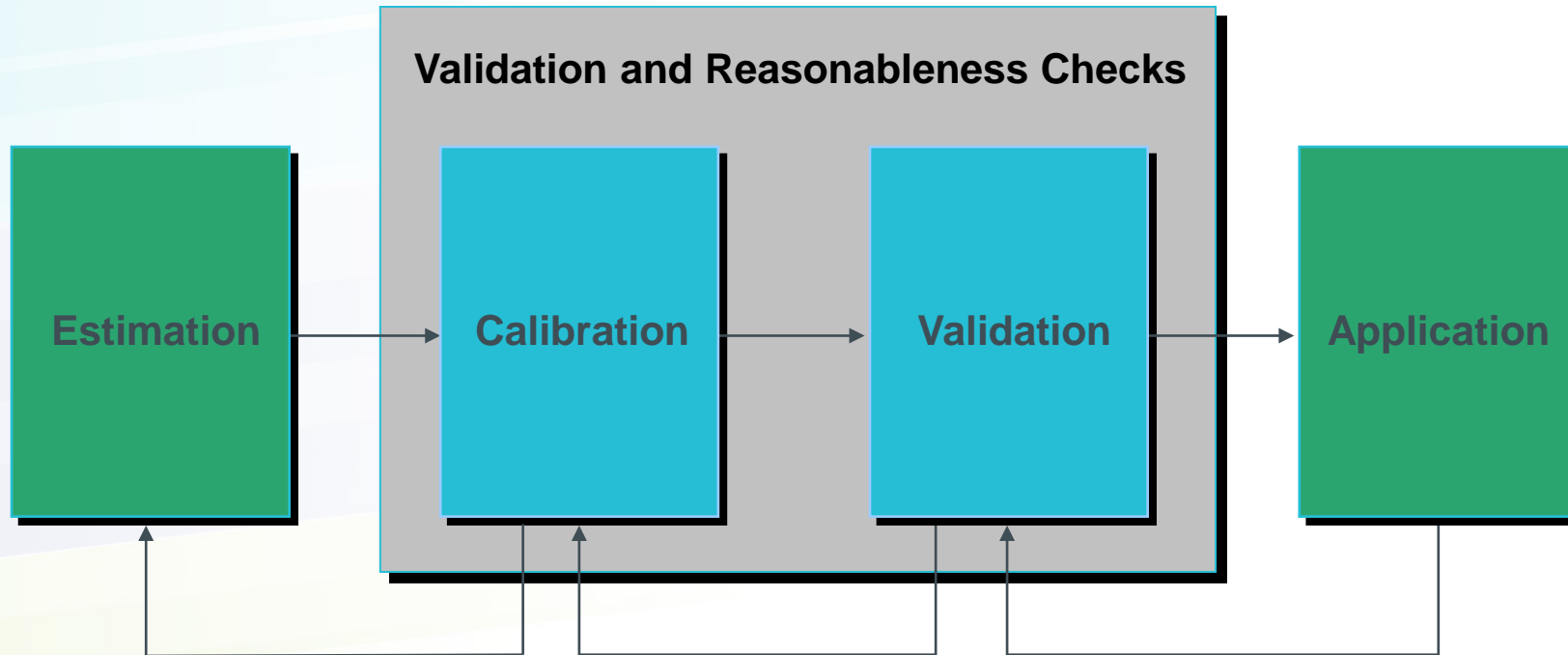
- A network-based model, **sensitive to roadway capacity**, that can be used for air quality conformity and regional planning studies
- Represents travel during different **time periods**
- Daily validation against **recent, credible data sources** using industry best practices
  - » Trip rates
  - » Trip distribution and travel times
  - » Traffic volumes
- An **easy-to-use user interface** (transition to TranCAD)
- **Training** on model development, validation, and model application
- Reasonable population and employment **forecasts** relying on local knowledge
- **Sensitivity** to changes in network capacities, population and land use

# Typical Model Components

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- **Trip generation** – How many trips are made to and from each zone on an average weekday
- **Trip distribution** – Matching up the origins and destinations to produce trip tables
- **Time of day** – What times of day the trips are made
- **Mode choice** – Which modes travelers used (*not used for Orange County model*)
  - » OCTC decided that the level of effort was not viable for this model update
- **External travel** – How many trips are made into, out of, and through the region, and where they enter and leave the region
- **Truck travel** – How many trucks travel within into, out of, and through the region, and where they go
  - » OCTC decided to defer to a later date. Truck movements accounted for during AQ emissions
- **Trip assignment** – Which routes the trips use from origin to destination

# *The Model Development Process*



# *Key Model Input*

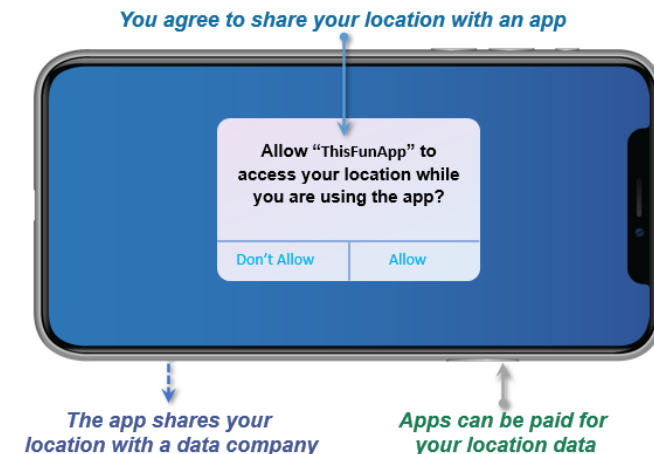
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- Transportation network
  - » Highway system (Used an enhanced OCTDM network)
- Socioeconomic/land use data
  - » Population
  - » Group Quarter population
  - » Households classified by income level
  - » Employment by type
  - » School enrollment

# Model Development Data Source

- The 2010-2011 NYMTC RHTS) - small sample size for Orange County
- Decision to use Location-based services (LBS) data for model estimation in conjunction with County population and employment data
- Main advantages of big data: Locational and temporal accuracy, larger sample size

- **LOCUS** – Location-based service (LBS) data platform developed by Cambridge Systematics
- Anonymized cell phone app location data
- Rigorous ground-truthing
- Represents total travel



# *Estimation*

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- Datasets Required
- Internal vs External Trips
- Trip Generation
- Trip Distribution

# *Datasets Required*

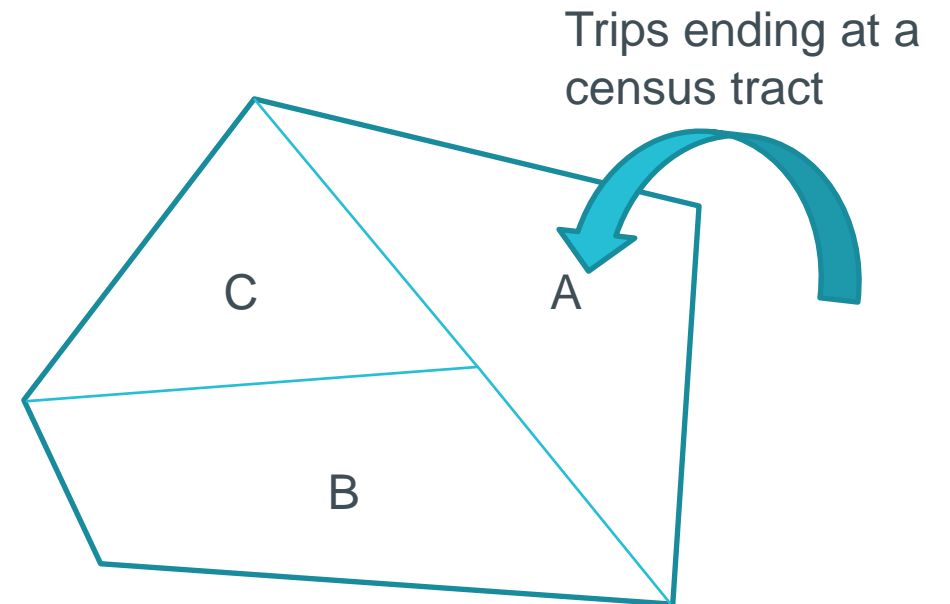
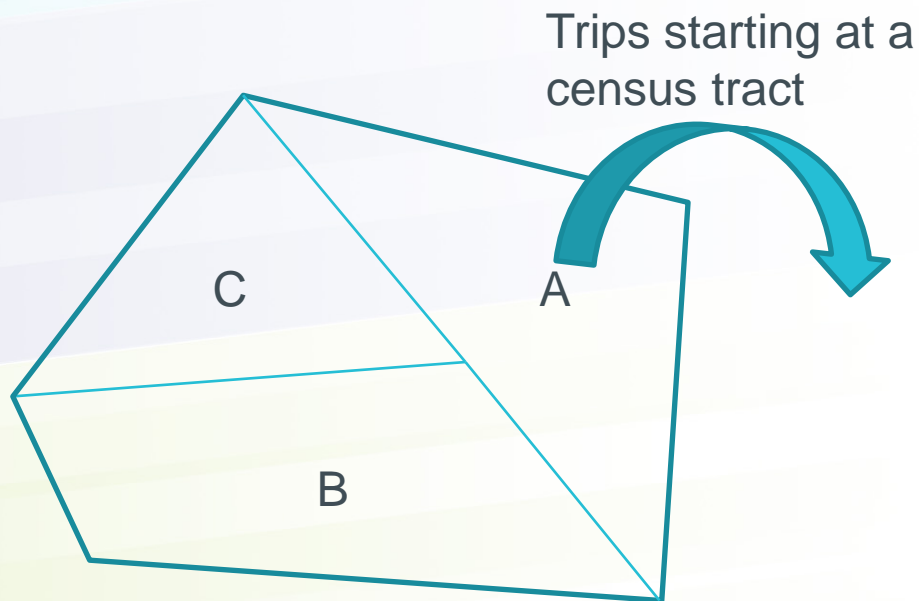
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- LBS (LOCUS) Trip Flows
- ACS data
- Count Data at external gateways
- Internal count data for validation, other validation data
- TAZ (consistent with Census) and Routable Network



# Model Structure

- Dependent variable – Trips starting at a census tract or trips ending at a census tract
- Independent variable – Socioeconomic characteristics of the CT such as households by income breakdown, population, employment etc.



# Internal Trip Generation Models

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- Separate models for trip origins and trip destinations
- Purposes
  - » Home to Work/School
  - » Work/School to Home
  - » Home to Other
  - » Other to Home
  - » Non-home based
- Time of day
  - » AM Peak - 6AM to 9AM
  - » Midday - 9AM to 2PM
  - » PM Peak - 2PM to 6PM
  - » Offpeak - 6PM to 6AM

$$Y = B_0 + B_1 X_1 + B_2 X_2 + \dots + B_n X_n$$

where:

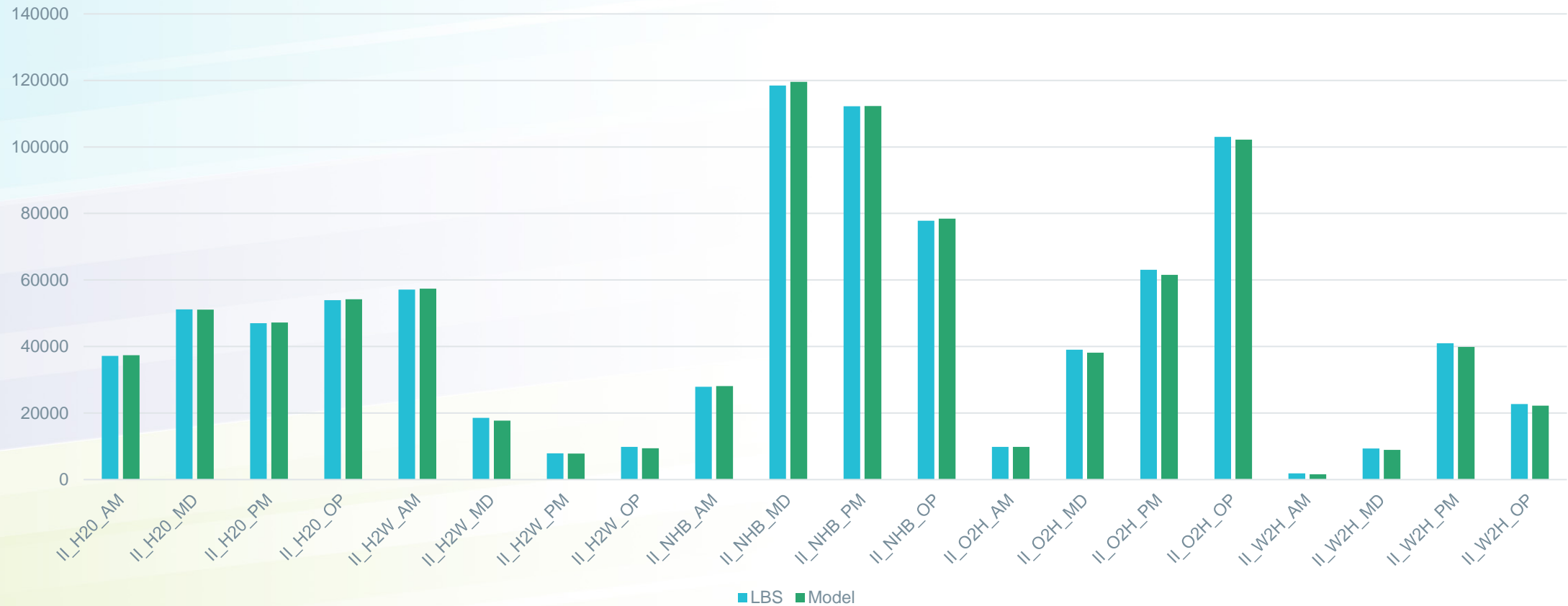
$Y$  = Dependent variable

$B_i$  = Estimated coefficients

$X_i$  = Independent variables

# Total Trips (Origin) – LBS vs Model

LBS vs Model Trip Origins

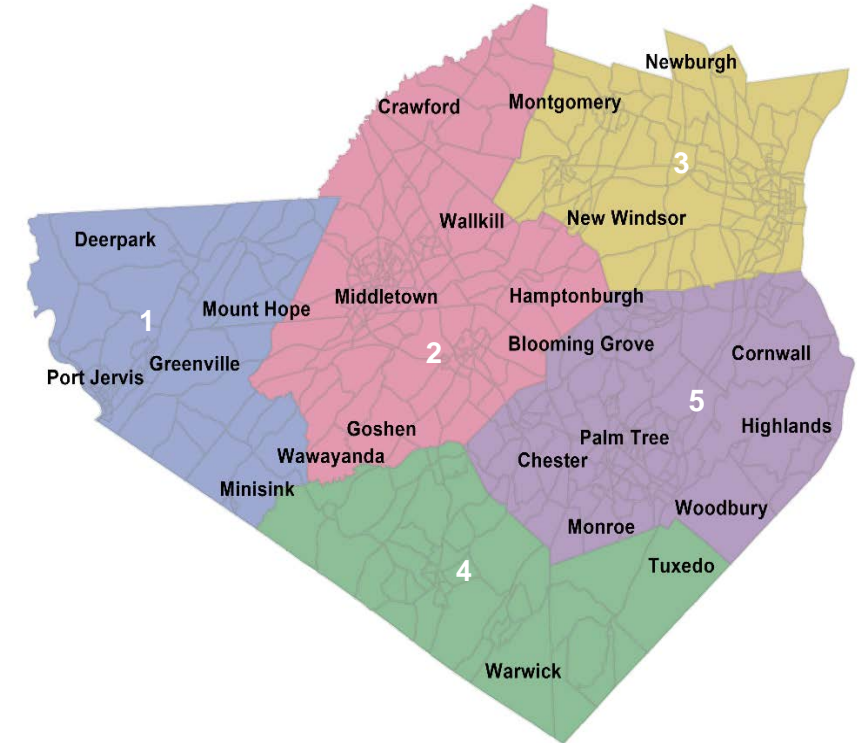


# District to District Flows - LOCUS

## Internal Home to Work/School Trips

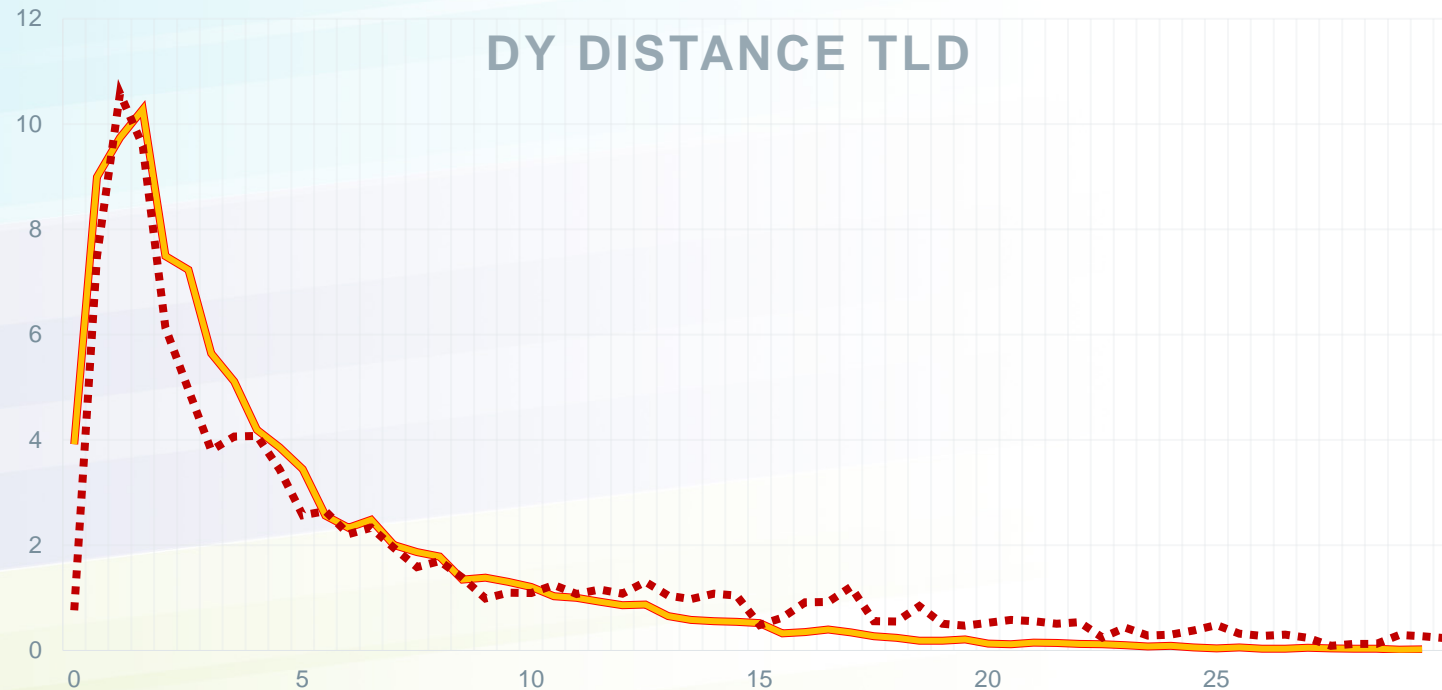
| Observed       | End District |       |       |      |       |        |
|----------------|--------------|-------|-------|------|-------|--------|
| Start District | 1            | 2     | 3     | 4    | 5     | Total  |
| 1              | 3.0%         | 3.8%  | 0.4%  | 0.2% | 0.5%  | 7.9%   |
| 2              | 0.3%         | 20.5% | 2.2%  | 0.8% | 2.9%  | 26.7%  |
| 3              | 0.0%         | 2.6%  | 21.6% | 0.1% | 4.8%  | 29.2%  |
| 4              | 0.0%         | 1.2%  | 0.1%  | 5.4% | 1.2%  | 8.0%   |
| 5              | 0.0%         | 3.0%  | 2.9%  | 0.8% | 21.5% | 28.3%  |
| Total          | 3.5%         | 31.1% | 27.2% | 7.3% | 31.0% | 100.0% |

| Modeled        | End District |       |       |      |       |        |
|----------------|--------------|-------|-------|------|-------|--------|
| Start District | 1            | 2     | 3     | 4    | 5     | Total  |
| 1              | 4.3%         | 3.4%  | 0.6%  | 0.4% | 0.7%  | 9.4%   |
| 2              | 0.3%         | 20.9% | 1.8%  | 0.6% | 2.1%  | 25.6%  |
| 3              | 0.1%         | 2.2%  | 22.6% | 0.2% | 4.1%  | 29.2%  |
| 4              | 0.1%         | 1.6%  | 0.3%  | 5.9% | 2.0%  | 9.9%   |
| 5              | 0.0%         | 1.8%  | 2.6%  | 0.8% | 20.6% | 25.8%  |
| Total          | 4.7%         | 29.8% | 27.8% | 8.0% | 29.6% | 100.0% |



# Trip Length Calibration

## ➤ Trip Length Distribution – Home to Work/School



|  |                |
|--|----------------|
|  | Target         |
|  | Previous Model |
|  | Current Model  |

# *External Travel Models*

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- Internal to External Trips
  - » Trip Origins Modeled
  - » Trip Destinations assigned to external nodes based on distribution of LBS data
- External to Internal Trips
  - » Trip Destinations Modeled
  - » Trip Origins assigned to external gateway based on distribution of LBS data
- External to External Trips
  - » Trips estimated based on distribution of LBS data

# ***VALIDATION/CALIBRATION***

# Trip Production Rates Comparison

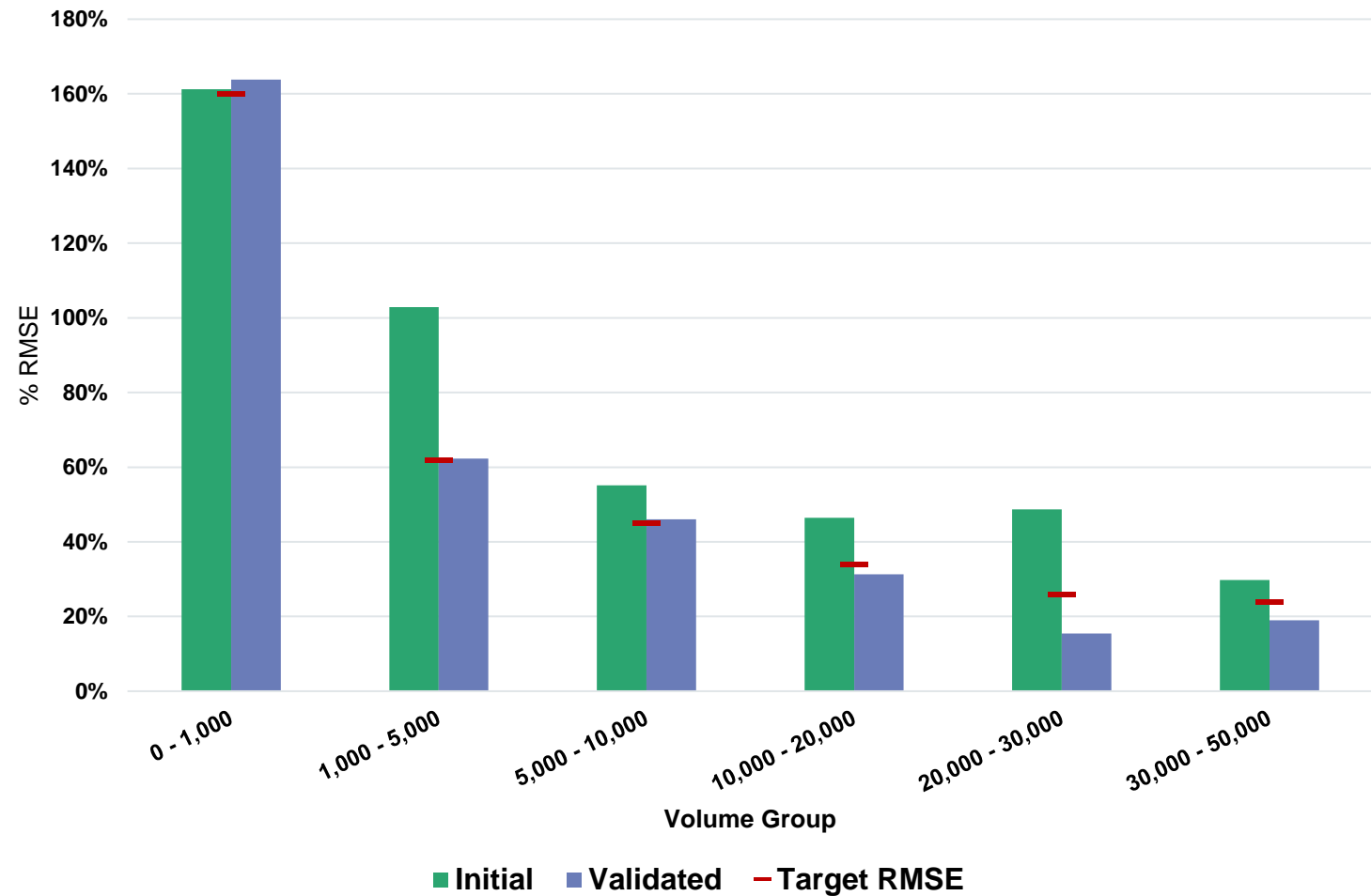




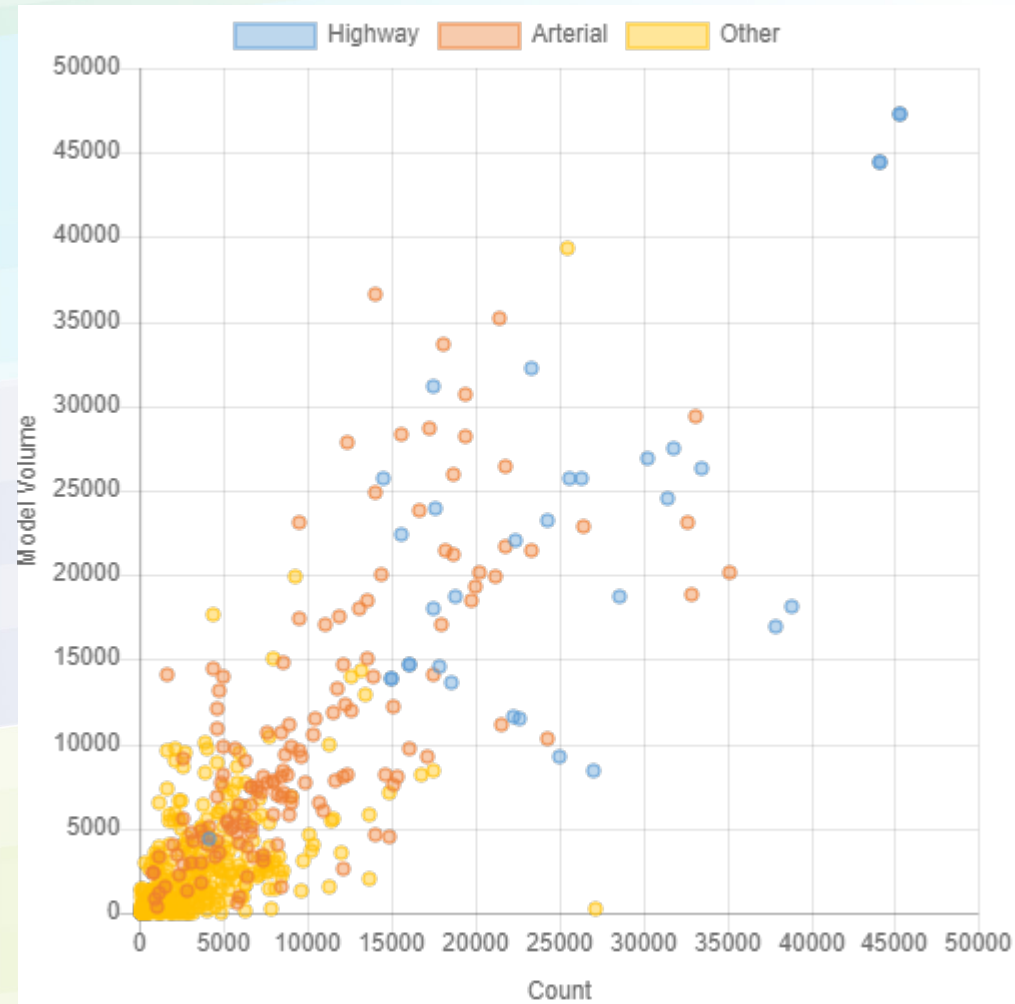
# % Root Mean Square Error

$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^N [(\text{Count}_i - \text{Model}_i)^2]}{N}}$$

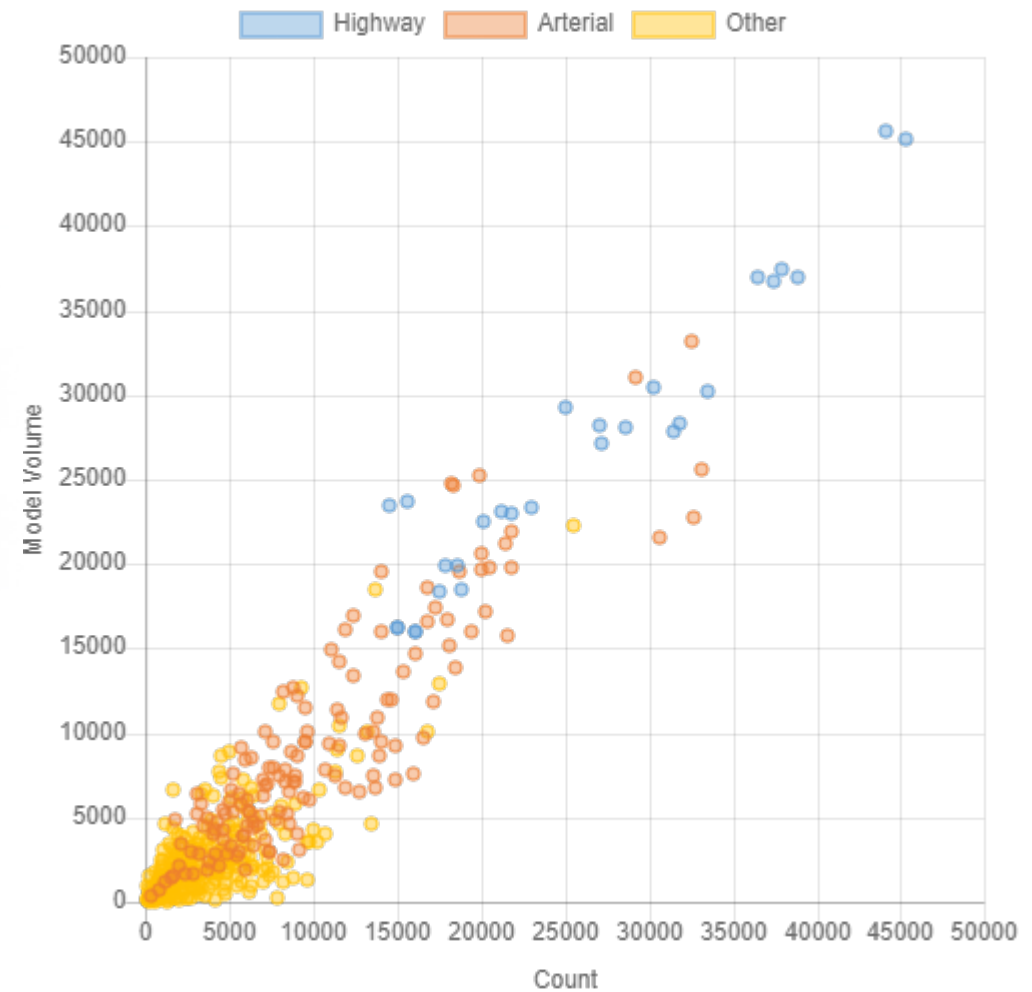
$$\% \text{RMSE} = \left( \frac{\text{RMSE}}{\left( \frac{\sum_{i=1}^N \text{Count}_i}{N} \right)} \right) \times 100$$



# Model Volume vs Count



Before Validation Model



Final Validation

# Daily Validation by Facility Type and Area Type

## Validation Summary (Daily, Entire Model)

|                    | Model/Count VMT | Modeled/Count Volume | % RMSE       | RMSE         |
|--------------------|-----------------|----------------------|--------------|--------------|
| Interstate         | 106.4%          | 106.3%               | 12.7%        | 3,311        |
| Highway            | 97.7%           | 97.4%                | 8.5%         | 2,167        |
| Principal Arterial | 97.5%           | 90.4%                | 29.9%        | 3,480        |
| Minor Arterial     | 91.7%           | 86.2%                | 41.8%        | 2,357        |
| Major Collector    | 68.6%           | 62.7%                | 72.6%        | 2,732        |
| Minor Collector    | 87.2%           | 84.9%                | 90.5%        | 1,227        |
| Centroid Connector | --              | --                   |              | 0            |
| <b>Total</b>       | <b>99.7%</b>    | <b>87.1%</b>         | <b>38.6%</b> | <b>2,745</b> |

## Modeled VMT / Count VMT (Daily, Entire Model)

|                    | Urban        | Suburban     | Rural         | Total        |
|--------------------|--------------|--------------|---------------|--------------|
| Interstate         | 95.0%        | 104.2%       | 107.3%        | 106.4%       |
| Highway            | --           | --           | 97.7%         | 97.7%        |
| Principal Arterial | 90.7%        | 88.8%        | 104.4%        | 97.5%        |
| Minor Arterial     | 60.5%        | 102.1%       | 93.9%         | 91.7%        |
| Major Collector    | 50.4%        | 54.7%        | 80.2%         | 68.6%        |
| Minor Collector    | 112.1%       | 102.2%       | 68.3%         | 87.2%        |
| Centroid Connector | --           | --           | --            | --           |
| <b>Total</b>       | <b>79.8%</b> | <b>93.4%</b> | <b>102.6%</b> | <b>99.7%</b> |

## Modeled Volume / Count Volume (Daily, Entire Model)

|                    | Urban        | Suburban     | Rural        | Total        |
|--------------------|--------------|--------------|--------------|--------------|
| Interstate         | 95.0%        | 103.4%       | 108.5%       | 106.3%       |
| Highway            | --           | --           | 97.4%        | 97.4%        |
| Principal Arterial | 87.5%        | 87.1%        | 96.0%        | 90.4%        |
| Minor Arterial     | 62.9%        | 93.1%        | 101.3%       | 86.2%        |
| Major Collector    | 49.2%        | 58.0%        | 77.1%        | 62.7%        |
| Minor Collector    | 94.7%        | 86.3%        | 75.0%        | 84.9%        |
| Centroid Connector | --           | --           | --           | --           |
| <b>Total</b>       | <b>73.7%</b> | <b>82.1%</b> | <b>95.9%</b> | <b>87.1%</b> |

# Screenline Validation

## Screenline Summary (All Links)

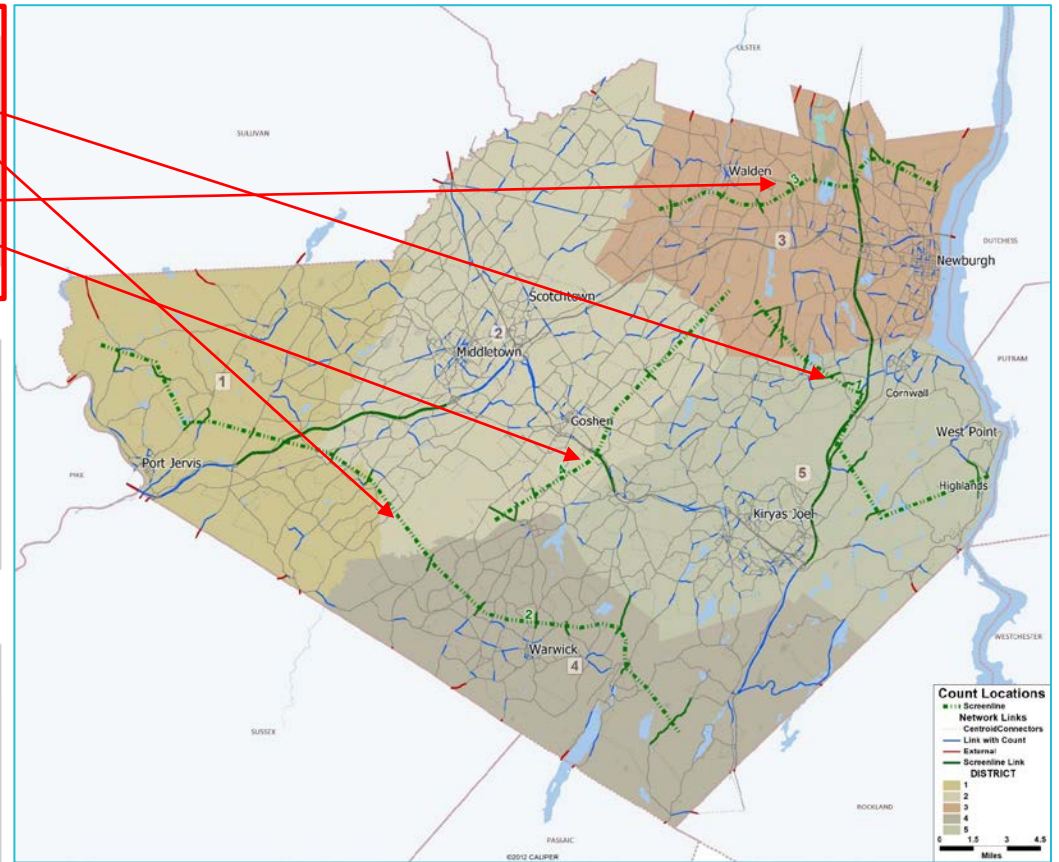
|                     | Model Volume  | Count Volume  | Model / Count |
|---------------------|---------------|---------------|---------------|
| Screenline 1        | 113,792       | 108,770       | 1.05          |
| Screenline 2        | 90,730        | 71,253        | 1.27          |
| Screenline 3        | 88,454        | 98,970        | 0.89          |
| <b>Screenline 4</b> | <b>81,464</b> | <b>85,397</b> | <b>0.95</b>   |

## Screenline Summary (Interstate Links)

|                     | Model Volume | Count Volume | Model / Count |
|---------------------|--------------|--------------|---------------|
| Screenline 1        | 57,427       | 52,102       | 1.10          |
| Screenline 2        | 47,158       | 30,091       | 1.57          |
| Screenline 3        | 46,346       | 44,761       | 1.04          |
| <b>Screenline 4</b> | <b>0</b>     | <b>0</b>     | <b>--</b>     |

## Screenline Summary (Non-Interstate Links)

|                     | Model Volume  | Count Volume  | Model / Count |
|---------------------|---------------|---------------|---------------|
| Screenline 1        | 56,365        | 56,668        | 0.99          |
| Screenline 2        | 43,573        | 41,162        | 1.06          |
| Screenline 3        | 42,108        | 54,209        | 0.78          |
| <b>Screenline 4</b> | <b>81,464</b> | <b>85,397</b> | <b>0.95</b>   |



***QUESTIONS?***

# ***EXTRA SLIDES***

# Key Differences and Improvements to the OCTDM

| Model Features        | Earlier Version OCTDM                       | Current OCTDM   |
|-----------------------|---|---|
| Software Platform     | Visum                                       | TransCAD  |
| Time Periods          | PM Peak Hour                                | 24-hour(capacity-constrained; four time periods)  |
| TAZ Layer             | -   | Consistent with Census geography  |
| Validation Data       | Weaker relationship with NYSDOT data viewer | Consistent with NYSDOT data viewer  |
| Model Validation      | Peak PM hour                                | Daily validation using guidelines from <i>-2011 Travel Model Improvement Program Travel Model Validation and Reasonableness Checking Manual – Second Edition (Cambridge Systematics, Inc., 2010</i> |
| Ease of Use           | Less user friendly according to OCTC        | Incorporated into TransCAD with a focus on user experience  |
| Documentation         | Limited availability                        | Model development and validation; user documentation  |
| External travel       | Related only to available count data        | More clarity around external travel using Location-Based Services (LBS) data  |
| Trip generation model | Outside of model platform                   | Incorporated within TransCAD  |
| Training              | -   | Provided extensive training to OCTC staff which included presentation decks   |