ODME Application in the Indiana Statewide Travel Demand Model

Transportation Planning Applications Conference

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INDOT

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Presentation Overview

- Development Team
- Indiana Statewide Model (ISTDM6) Overview
- American Transportation Research Institute (ATRI) Data
- Traffic Counts
- Origin Destination Matrix Estimation (ODME) Application
- Model Validation
- Conclusions

ISTDM6 Model Development Team

- Indiana DOT
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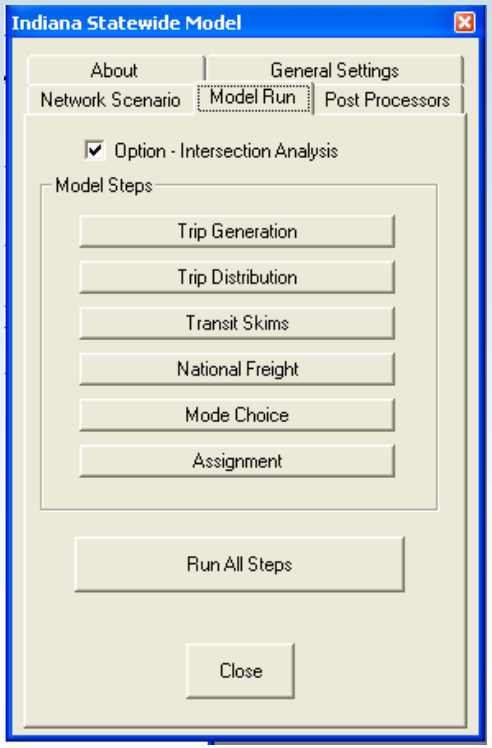
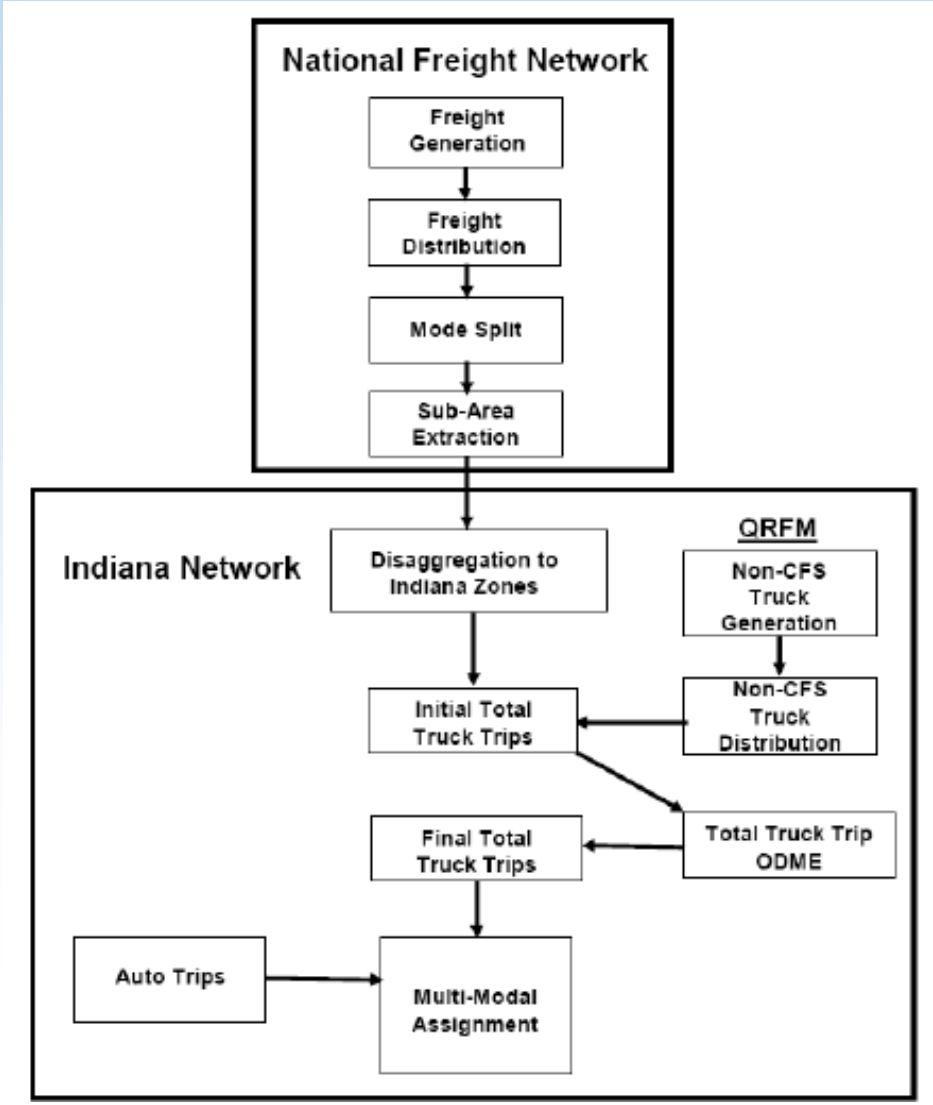
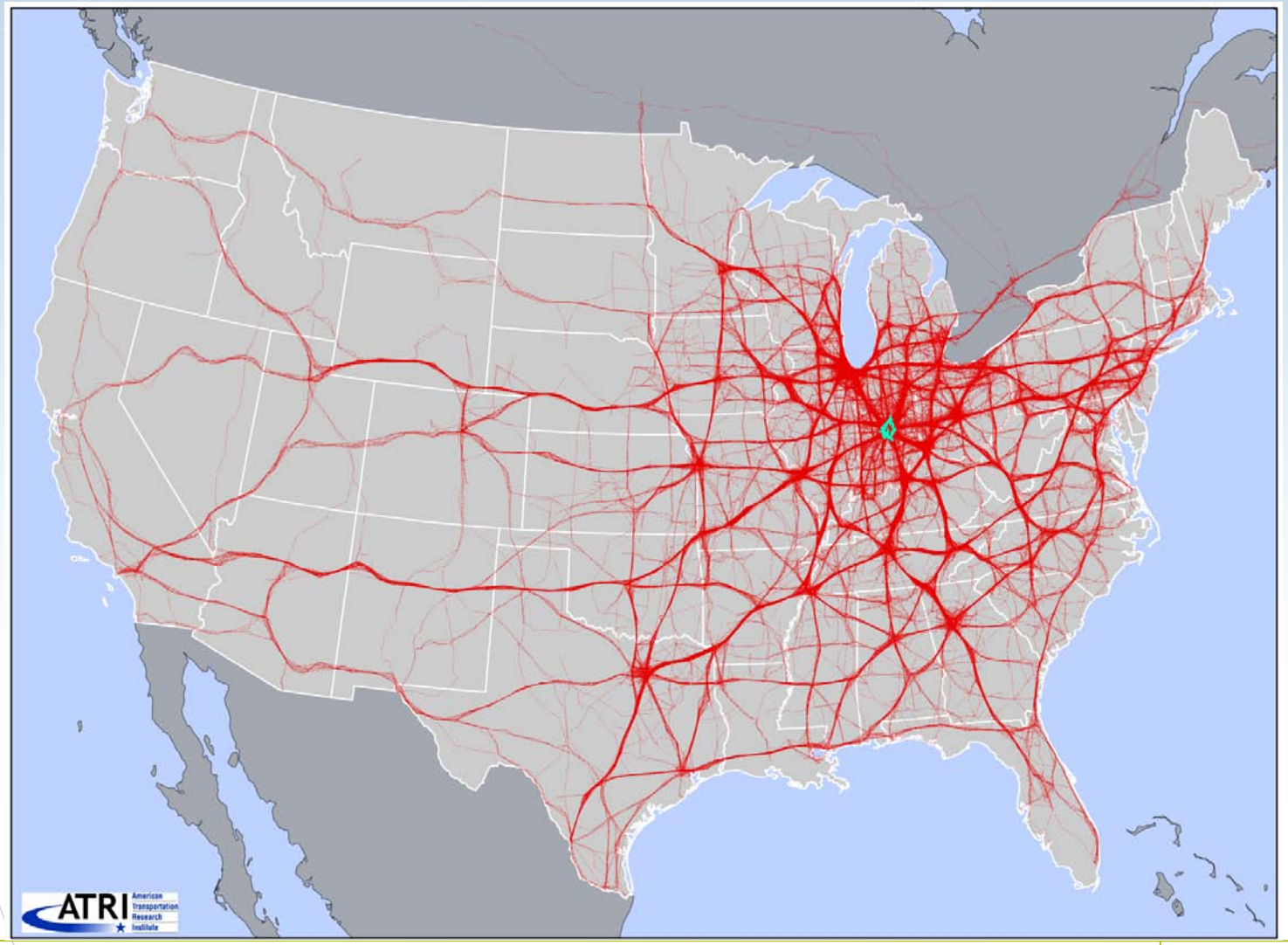
  - Roy Nunnally
- CDM Smith
  - Rob Bostrom
  - Liza Amar
- RSG, Inc
  - Vince Bernardin
- The Corradino Group
  - Dean Munn

ISTDM6 Overview



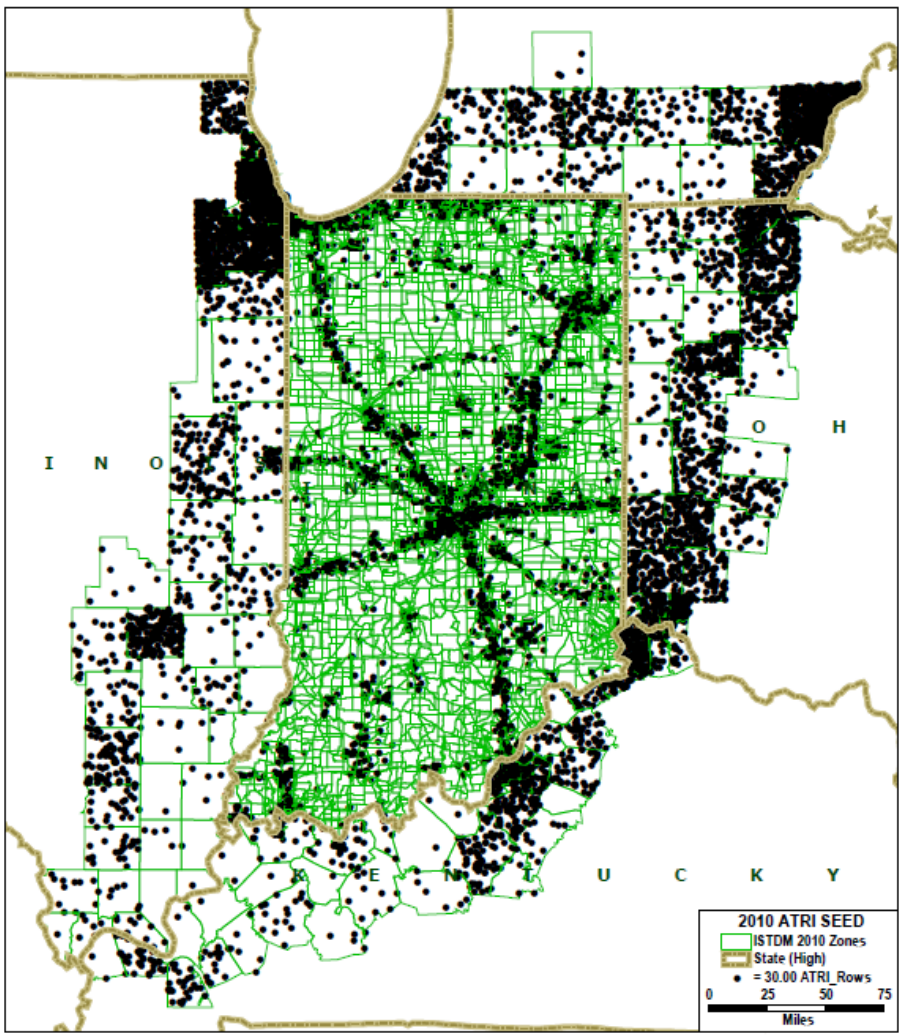


ATRI Data



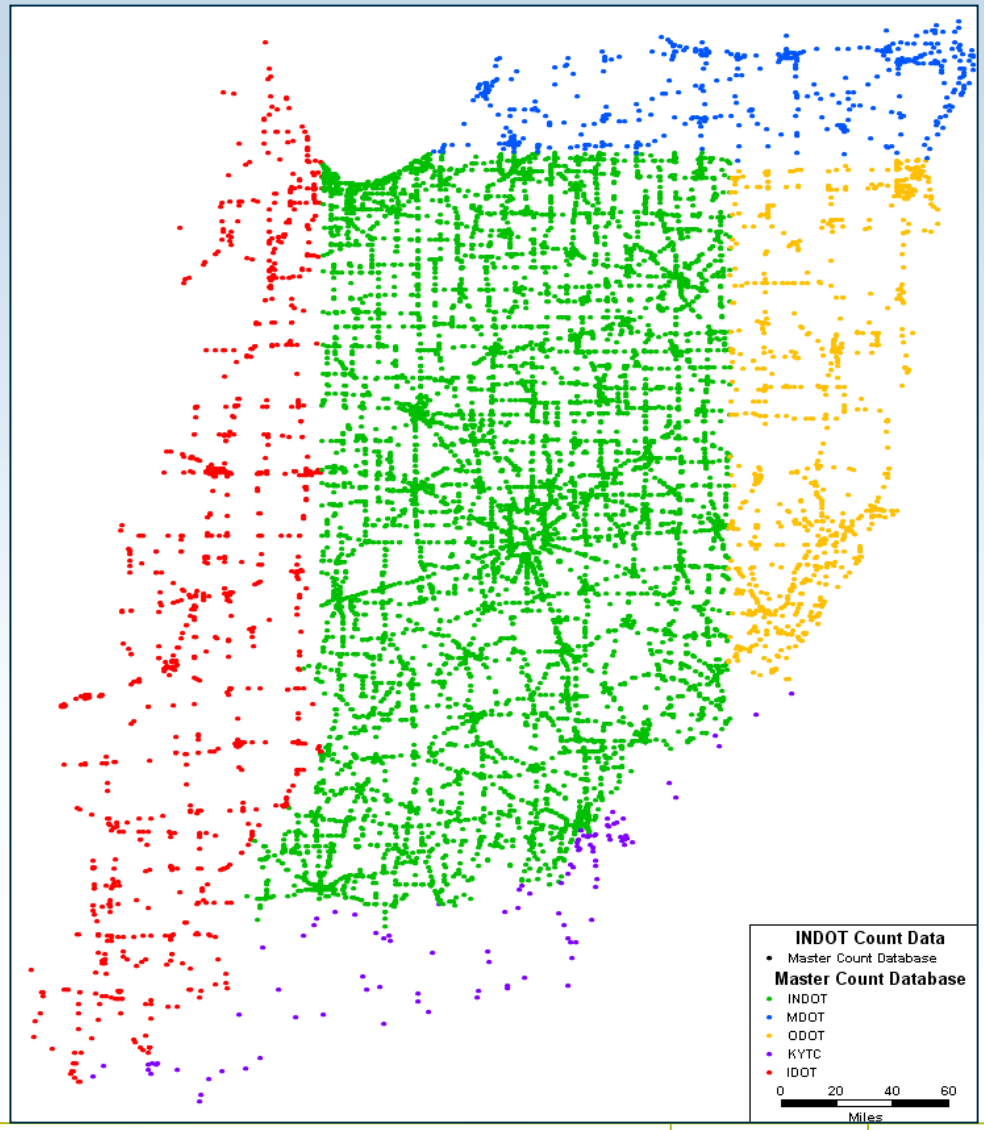
ATRI Data

- Processed data products
  - avoid disclosure
  - multiple sources
  - date, time, coordinates
- Eight week sample of trucks
- 16 million records = 305,000 trucks
- Screening out locations
  - truck stops / rest areas
- Filter dataset
  - continuous moving records
- Weighted data for seasonality
- Scaled for daily trips



Traffic Counts

- AADT
  - ATR
  - WIM
  - IFORMS
  - TRADAS
- Classification Counts
  - Auto
  - 4-Tire Commercial Vehicle
  - Single Unit (SU) Trucks
  - Multi-Unit (MU) Trucks
- Count Statistics
  - Functional Classification
  - Area Type



ODME Application - Motivation

- Improve accuracy
- Maintain existing model structure
  - National Commodity Flow
  - “Non-Freight” trucks based on Quick Response Freight Manual (QRFM)
  - ODME Adjustments
- Use ATRI data to derive OD tuck-trip tables for the ISTDM6

ODME Application – Sensitivity

- Count Sensitivity
  - Locations (I-69 vicinity)
  - Outliers
  - Weights

Area	Count Weight
Within Indiana	1.00
Fringe Area	0.25
External Stations	1.00

- Seed Matrix Sensitivity
  - What does seed matrix represent?
- Application Sensitivity
  - Static Assignment with preload vs. Multi-Modal Multi-Class Assignment (MMA)
  - ODME iterations
  - No Count Paths

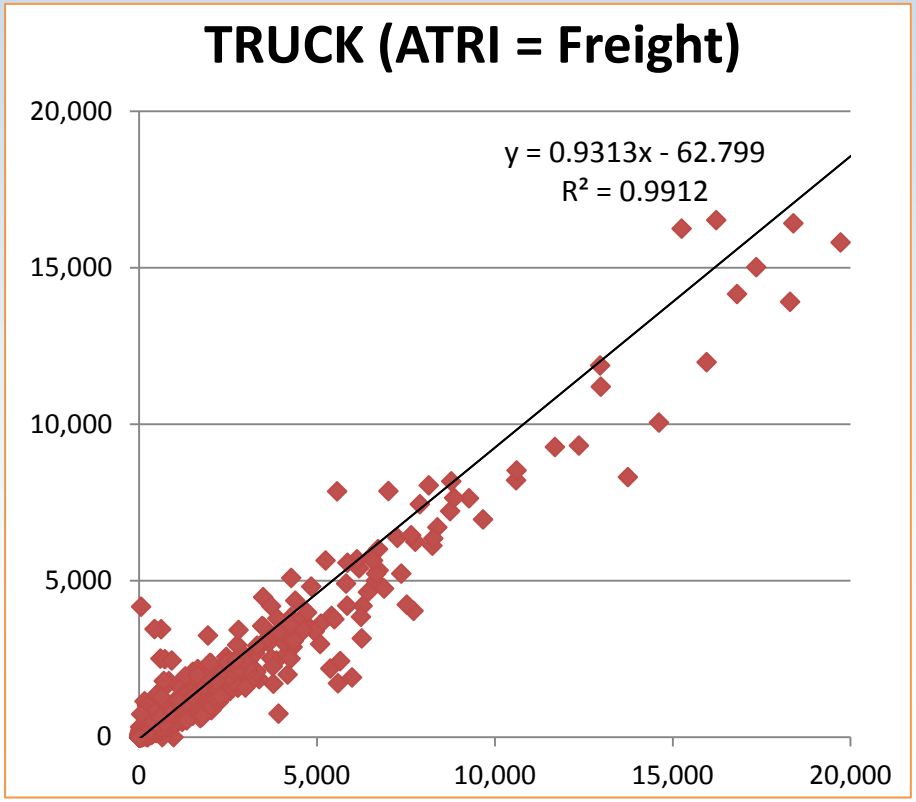
ODME Application – Sensitivity

- Auto and truck input seed matrices
- What does the ATRI data represent?
  - Long distance commodity flow trucks (Freight)
  - Multi-unit local trucks
  - Single unit local trucks
  - Mix of the above
- What percentage of these does the sample represent?

Area Type	ATRI Volume	Truck Count	ATRI % of Count	Freight % of Truck Loading
Urban	712,260	2,450,755	29.1%	29.0%
Suburban	132,835	383,219	34.7%	31.8%
Rural	1,705,215	4,617,369	36.9%	36.5%

ODME Application – Sensitivity

- ATRI = Freight
- Root Mean Square Error (RMSE) on Trip Tables
- Percent Difference
- District Comparison



ATRI Reflects	RMSE	% Seed/ODME
ATRI	5.81	42.0
All Trucks	6.24	41.0
MU + Freight	3.62	14.9
Freight	3.26	-9.8

ODME Application – Results

- MMA ODME procedure
- Tighter convergence criteria improved the RMSE
  - 200 iterations & 0.0001 relative gap for 7 ODME iterations
- Weighting counts by area
- Auto = auto + external + 4-tire commercial vehicle
- Truck = freight (ATRI) + SU truck + MU truck

Mode	Input SEED	Output ODME	% Difference
Auto	41,033,462	42,819,951	4.2%
Truck	2,524,549	2,976,922	15.2%

ODME Application – Implementation

- Previous model ODME adjustment based on the additive approach
  - (ODME – Base Model) + Model
- ODME adjustment considerations
  - additive approach: (ODME – Base Model) + Model
  - multiplicative approach: (ODME / Base Model) * Model
  - averaging of additive and multiplicative approaches
- ODME adjustments applied to auto and truck
  - Including 4-tire commercial vehicles and externals

Model Validation – Base Year Comparison

- 2010 updated ISTDM model compared with 2006 model

Auto + Truck	2006 Model	2010 Model
Observations	19,875*	7,912
RMSE	43.0%	25.9%
% Error	1.1%	-0.3%
*Based on the highway network because unknown from validation report		

- 2010 updated ISTDM truck model compared with 2006 truck model

Truck	2006 Model	2010 Model
Observations	6,689	4,200
RMSE	69.3%	38.4%
% Error	5.4%	-4.6%

Model Validation - Link Based Results

- Volume % Error
- RMSE
- VMT % Error

Functional Class	Obs.	Sum Count	Sum Flow	Volume % Error	RMSE (%)	VMT % Error
R. Interstates (1)	103	2,834,641	2,747,723	-3.1	10.3	-4.2
R. Prin. Arterials (2)	1,026	8,897,883	9,063,922	1.9	16.8	2.5
R. Minor Arterials (6)	1,334	7,972,920	8,060,792	1.1	21.7	2.0
R. Major Collectors (7)	2,756	9,554,756	9,522,050	-0.3	27.8	0.4
R. Minor Collectors (8)	29	149,577	153,079	2.3	27.5	7.7
R. Local Roads (9)	9	27,492	26,538	-3.5	40.6	-27.4
U. Interstates (11)	176	12,445,283	11,754,250	-5.6	14.6	-5.1
U. Freeways (12)	98	2,091,657	2,072,229	-0.9	21.4	-3.4
U. Prin. Arterials (14)	1,843	29,826,794	30,098,971	0.9	20.4	0.4
U. Minor Arterials (16)	493	5,015,258	5,090,145	1.5	28.2	0.3
U. Collectors (17)	43	390,877	379,005	-3.0	29.8	-2.4
U. Local Roads (19)	2	11,868	13,329	12.3	23.2	6.5
Total	7,912	79,219,005	78,982,032	-0.3	25.9	-1.5

Model Validation – Forecast Year Comparison

- Auto trips growth consistent with household/population growth
- Truck trips growth consistent with FAF growth

Trip Purpose	State of Indiana				Model Area (including fringe area)
	2010 Trips	2035 Trips	Difference	Growth	Growth
Auto	13,661,832	15,449,007	1,787,176	13%	16%
QRFM Truck	835,636	920,798	85,162	10%	10%
4TComVeh	1,181,192	1,357,568	176,376	15%	17%
Freight Truck	16,883	22,472	5,589	33%	64%
Total	15,695,543	17,749,846	2,054,303	13%	16%

Indiana-to-Indiana	2010	2035	Growth
Model VMT	31,305,758	45,125,617	44%
FAF (KTons)	275,783	384,766	40%

Conclusions

- Accurate count data is critical for success of the ODME application.
- Interstate counts, especially in rural areas were most sensitive to the ODME results.
- Weights by facility type did not improve ODME results as much as weights by area.
- MMA ODME with tighter convergence improved ODME results more than single class assignment with preload.
- Implementation using additive approach is necessary to avoid skewed forecasts using multiplicative approach, even with special bounds.

Conclusions

- Found ATRI data representing freight improved Indiana truck model's performance.
- ODME application allowed for reasonable model forecasts which may not have been obtainable without the adjustments.
- ISTDM6 is acceptable for planning purposes and its use in traffic forecasting studies.
  - I-69 EIS Studies
  - I-70 Feasibility Studies
  - Other Corridor Studies
  - Toll Studies
  - Non-MPO Studies

Questions?

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