Staging Development of Edmonton Citywide Dynamic Traffic Assignment Model

Xu Han, Rajib Sikder,Peter Xin and Arun Bhowmick
City Planning, City of Edmonton

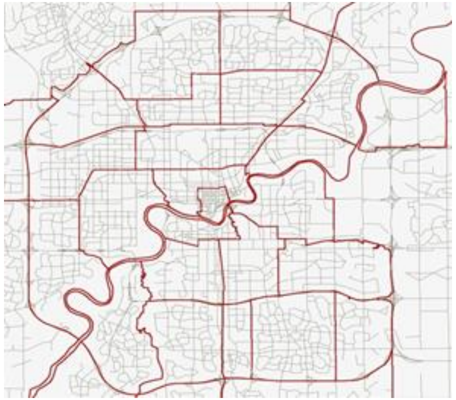
Agenda

- DTA Model Development
  - Demand preparation
  - Network building/debugging
  - Calibration and validation
- Example of Case Study
- Results and Applications
- Findings and recommendations

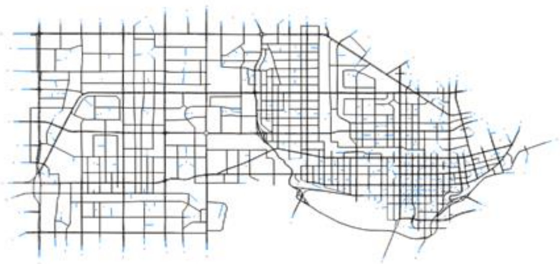
What is Dynamic Traffic Assignment (DTA)

Traffic operational analysis for Transportation Planning projects – intersection volume forecast, MoEs

Macro → **Meso** → **Micro**



Dynamic Traffic Assignment (DTA)

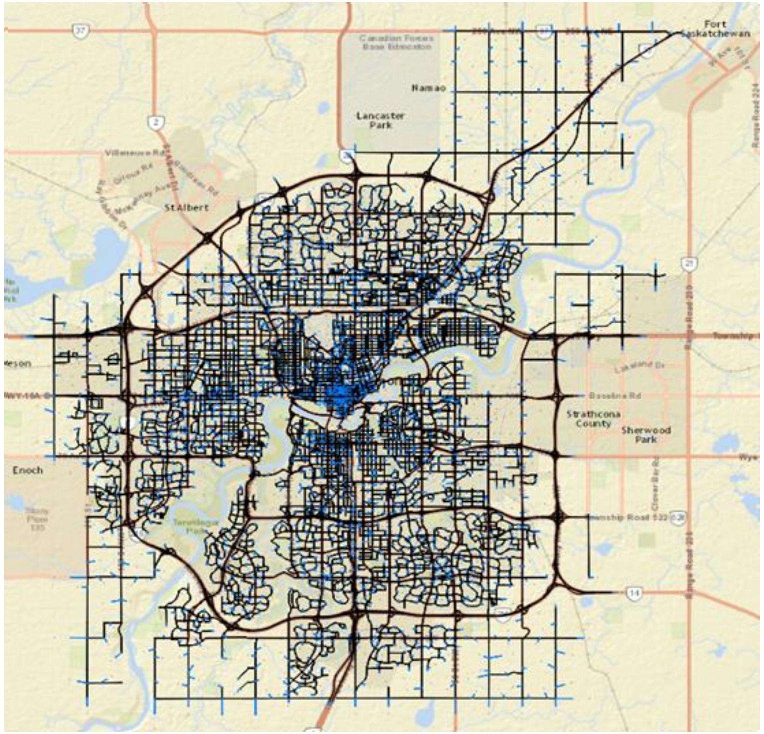


Model Background

- Why we develop?
  - Increasing demand of DTA for planning operational inquires
  - Develop and maintain DTA models piece by piece is time consuming

- How we developed? **Staging Development**
  - Corridor level
  - Inner Ring Road subarea
  - Valley Line LRT subarea
  - City Wide

DTA Staging Development



Stony Plain Road Pilot Study

↓

Downtown Accessibility Study

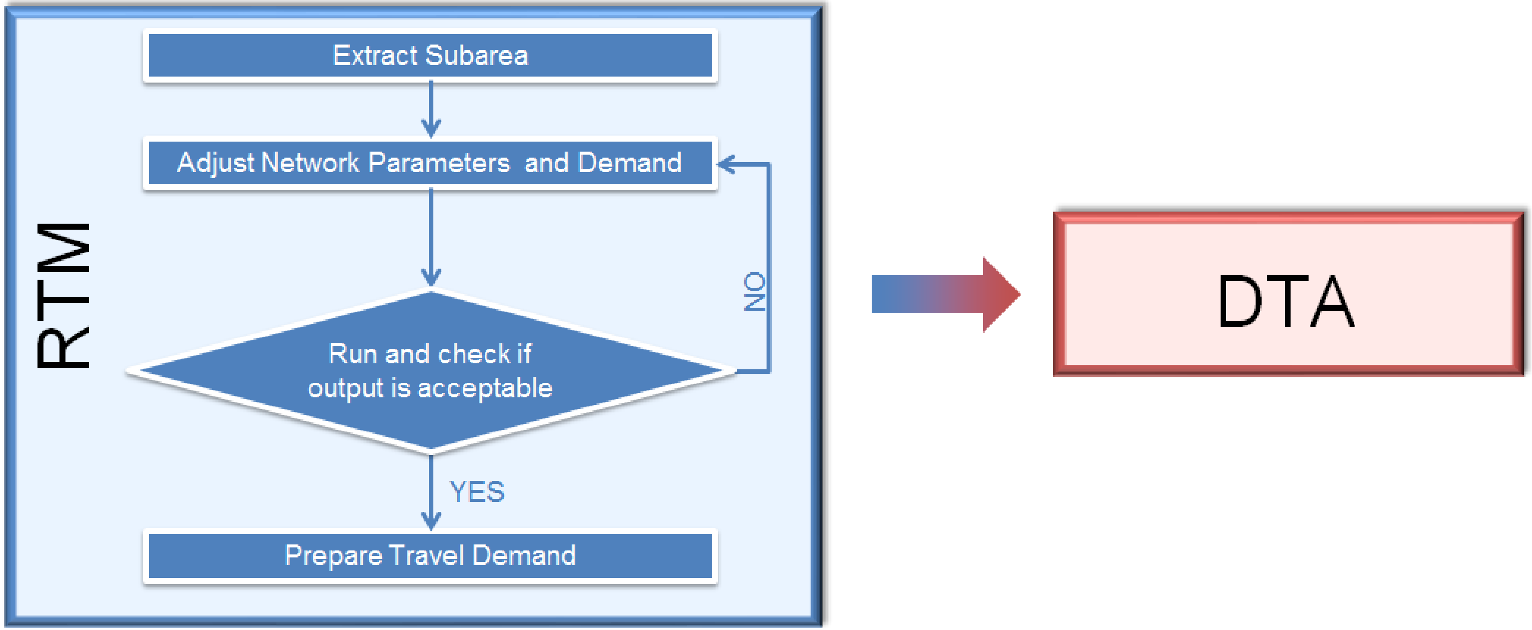
↓

Valley Line LRT Study

↓

City Wide

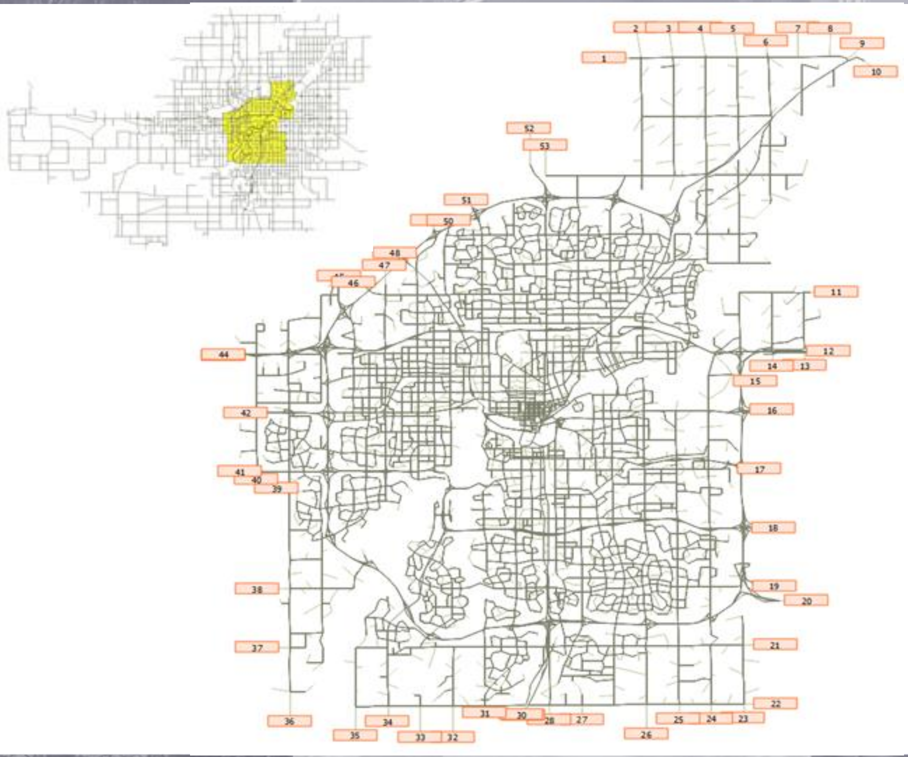
Base Year Demand Preparation



Edmonton

1 - Subarea Extraction

- Subarea followed city boundary
- 6 classes of vehicles
- Transit, pedestrian, and bike network not included
- Further network adjustment
- Finer zones to match DTA zone system



2 - Traffic Count Data Collection

- Data type
  - Turning movement counts (preferred)
  - Link volumes
- Year & Season
  - 2015>2014>2013>2012
  - Fall>Spring
- Time period
  - AM (6:30-9:30)
  - PM (15:30-18:30)
- Time interval
  - 15min and 1h
- Vehicle class
  - Auto and light truck
  - Truck

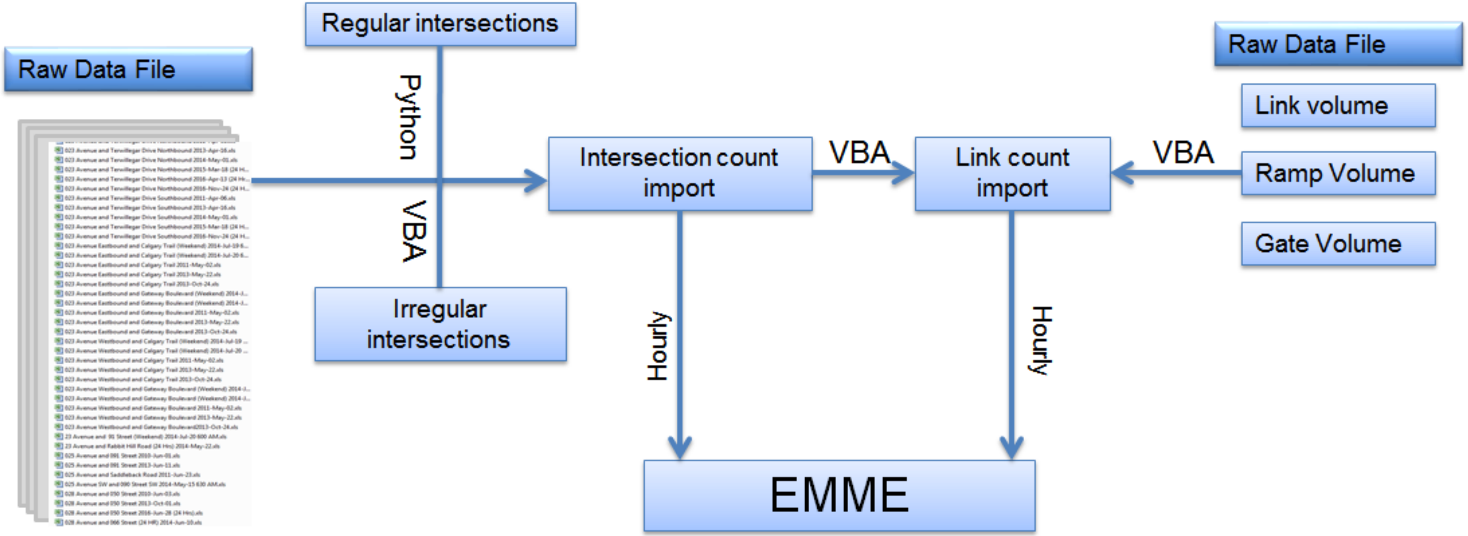
Intersections	Links	Ramps	Gates
418	29	219	36

Count locations

- Major signalized intersections
- River crossing
- Freeway ramps

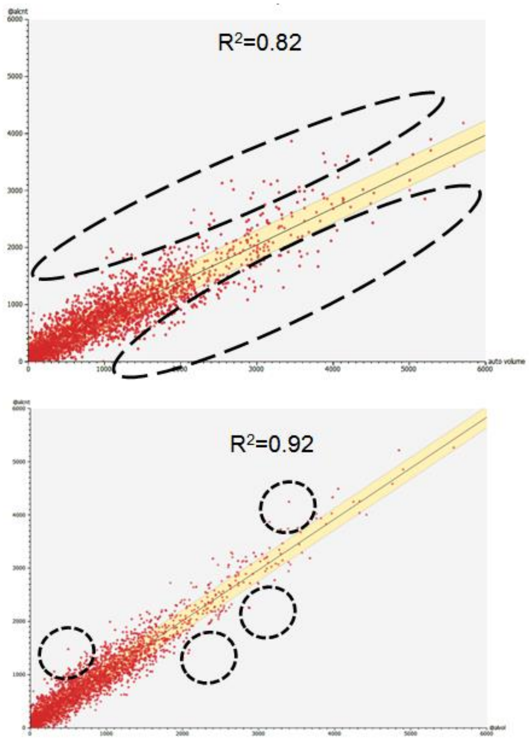
3 - Traffic Counts Import

- Semi-automation process: Python+VBA
- Converted intersection turning volumes to link volumes
- Aggregated 15 min interval to 1 hour



Network Debugging

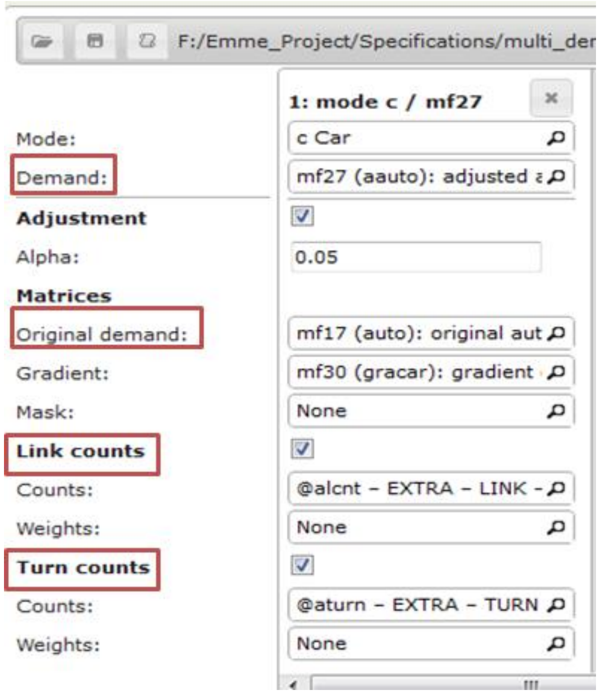
- Explored locations far away from identity line in scatter plot
- Made sure count data are appropriate at those locations
- Reviewed and checked parameters:
  - Zone access and locations
  - Link modes
  - Number of lanes
  - Link length
  - Volume-delay function
  - Link posted speed
  - Turn bans
  - Turn penalty function
- Re-assigned traffic and evaluated how model volumes matched counts



Edmonton

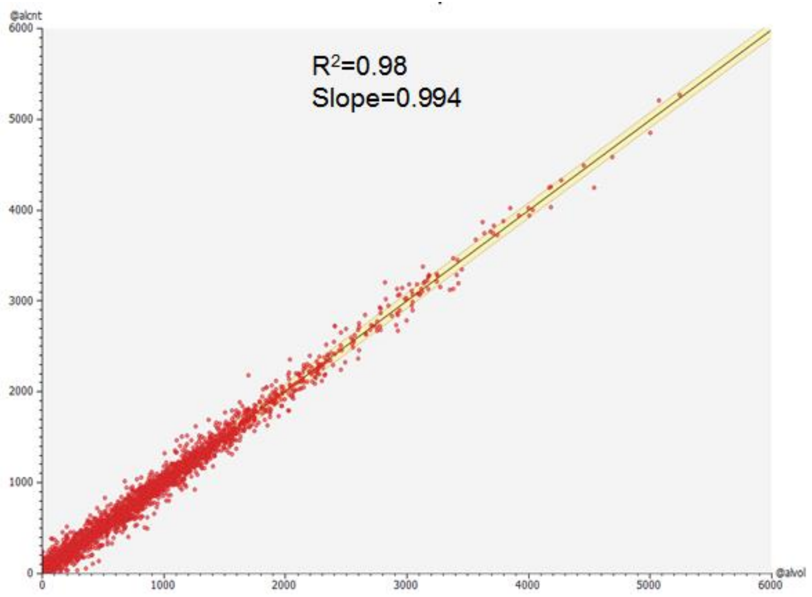
Demand Adjustment

- Only if after network debugging, assignment still needs to be improved
- Toolbox in EMME
- Objectives:
  - To minimize the difference between observed counts and assigned volumes
  - To minimize the difference between adjusted matrix and original matrix



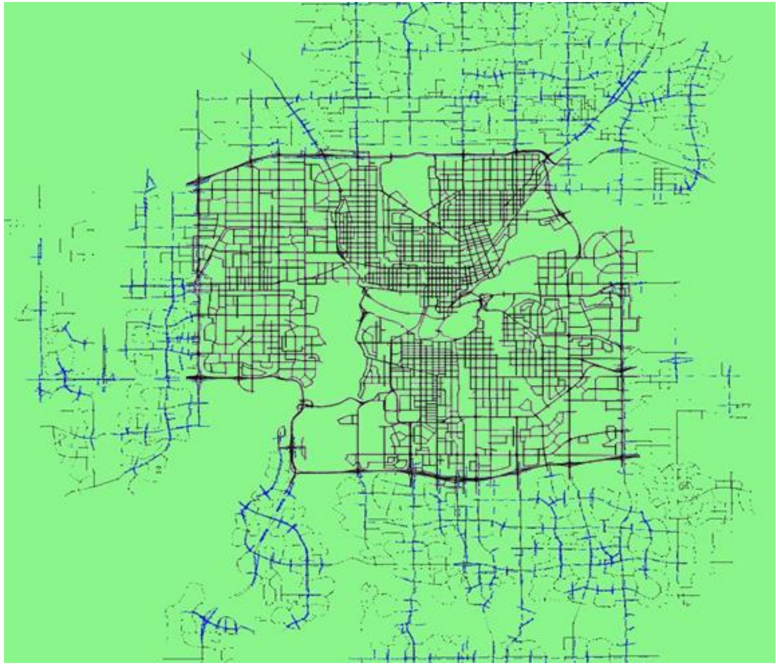
Demand Import

- Prepared O-D matrix for DTA import
  - Pre peak (15:30-16:30)
  - Peak (16:30-17:30)
  - Post peak (16:30-17:30)



City Wide DTA Model Network

- Start from Synchro Network
  - Major Arterial
  - Signal Time
  - Stop/Yield Control



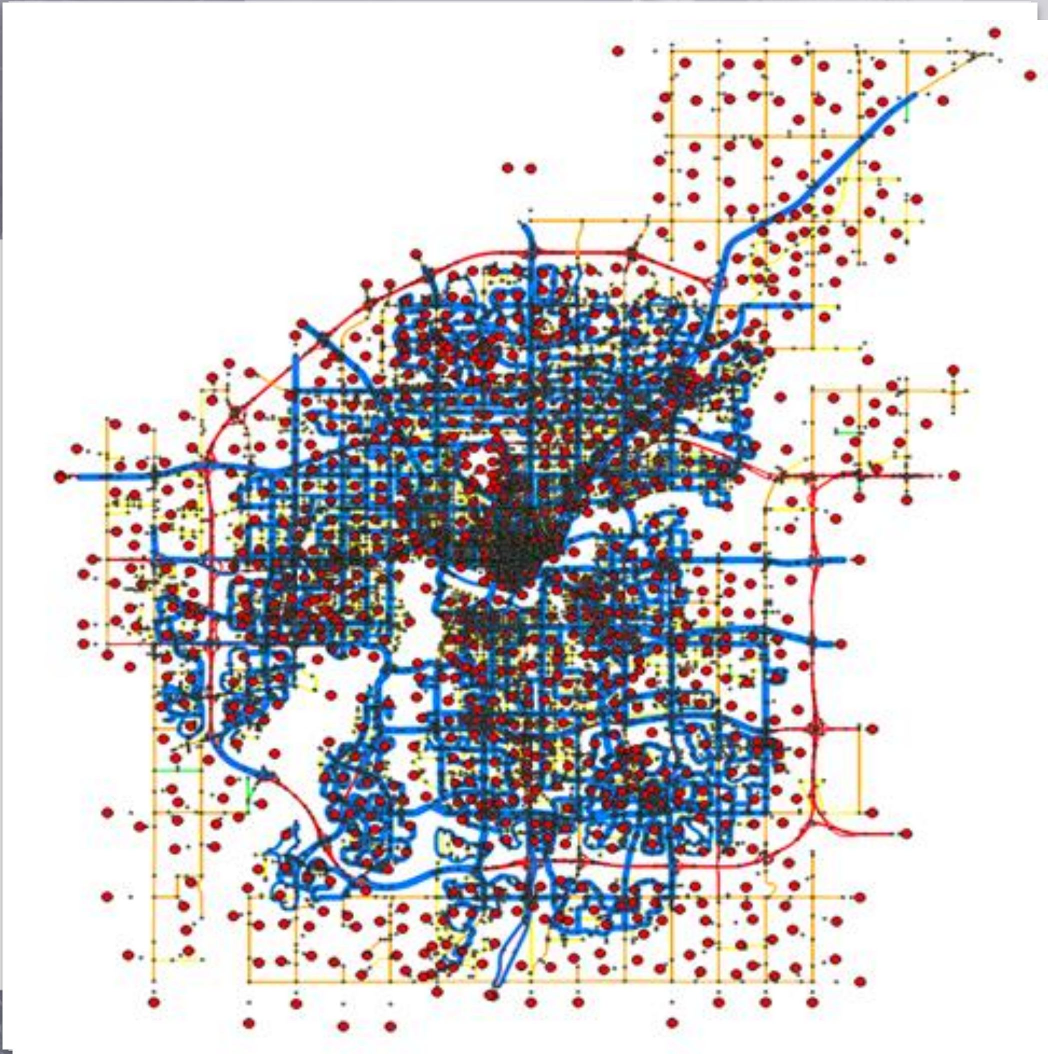
Nodes: 11647

Links: 29748

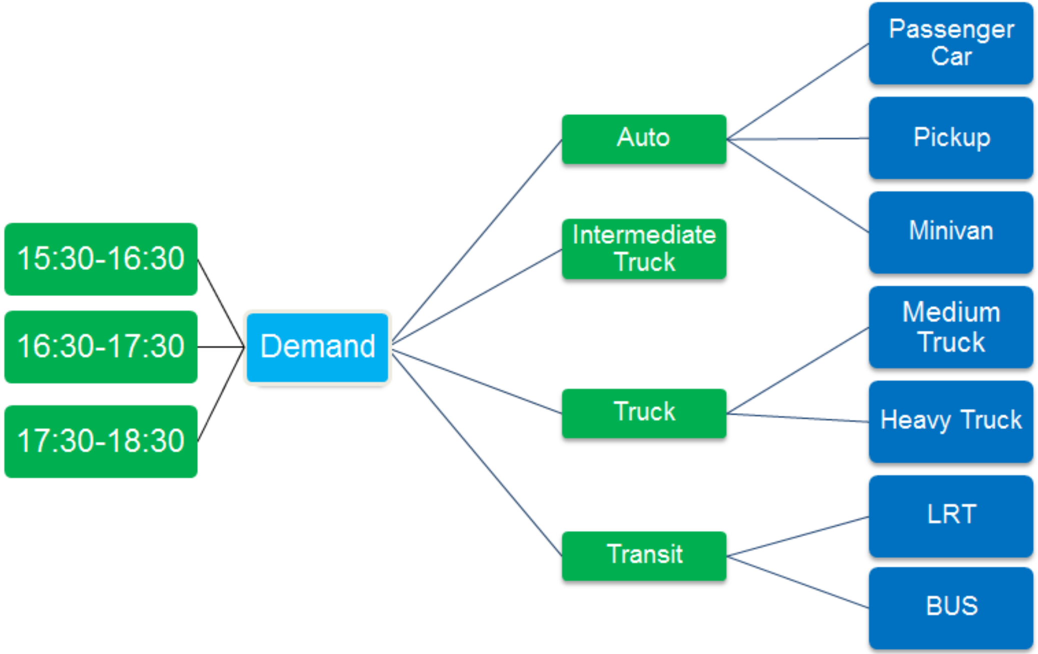
Signals: 1059

Transit Lines: 383

Zones: 1119

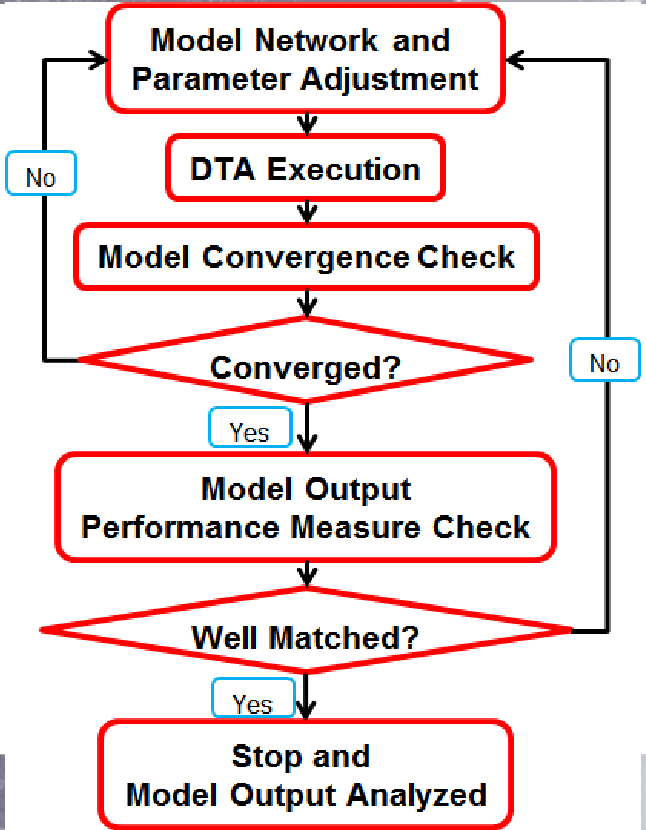


PM Peak Demand Structure



- Vehicle classes were characterized with effective length, response time and maximum speed
- EMME truck demand (in EPCU) required conversion to vehicles

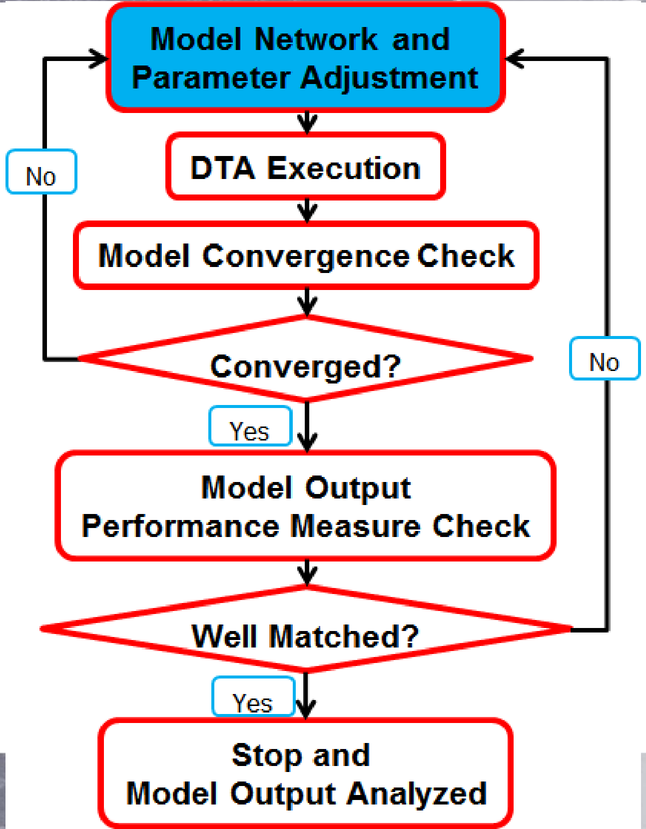
DTA Calibration Procedure



DTA Calibration Procedure

<u>Network Issues</u>:
- number of lanes
- node movement priority rules
- signal timing plans

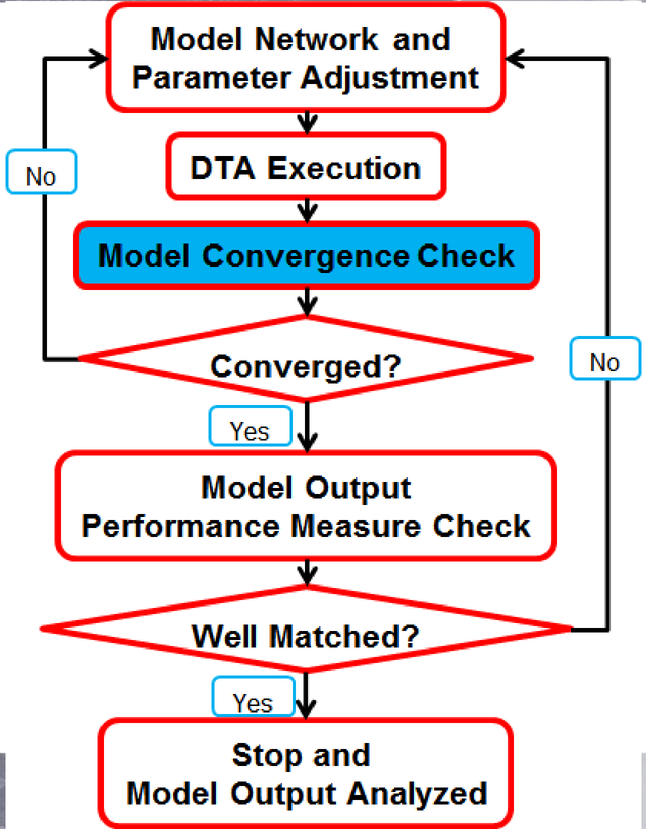
<u>Capacity Issues</u>:
- protective and permissive capacities
- follow-up times

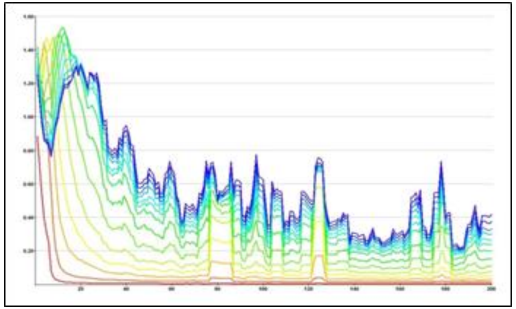


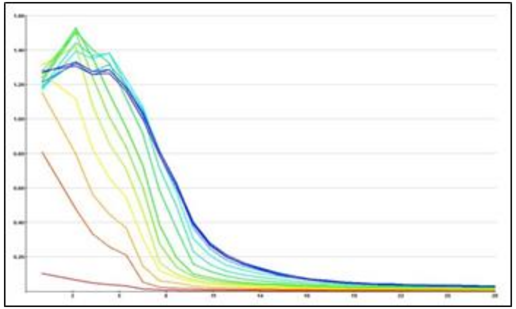
DTA Calibration Procedure

Model Convergence is the comparison between average travel time and shortest travel time for all O-D pairs

Possible to find which O-D pair(s) has high relative gaps





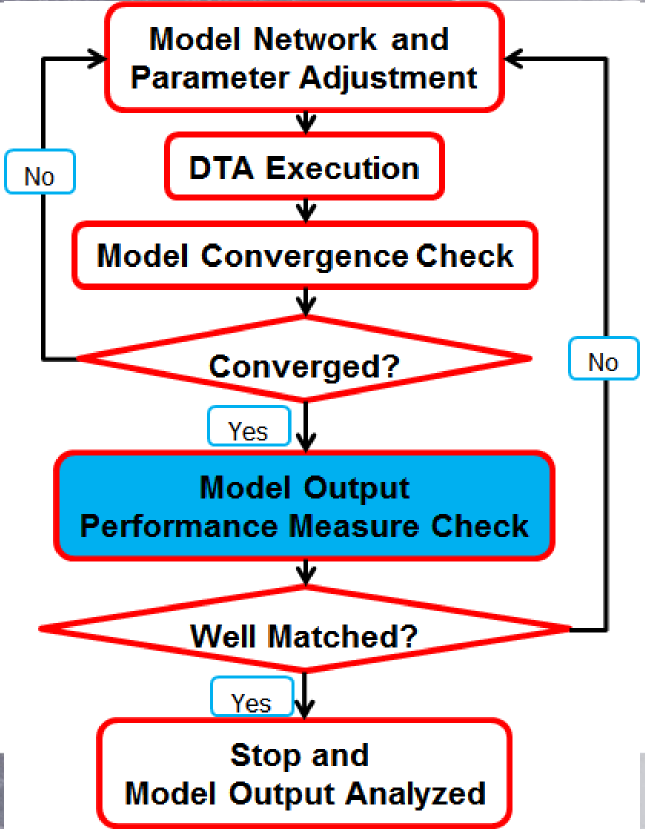


DTA Calibration Procedure

Traffic short cutting
- 30s Left turn penalty
- 10s right turn penalty

Link distance cost
- Local road (sec): 0.05*length(m)
- AHD (sec): 0.01*length(m)
- Link truck cost: 3min every 100m for non truck routes

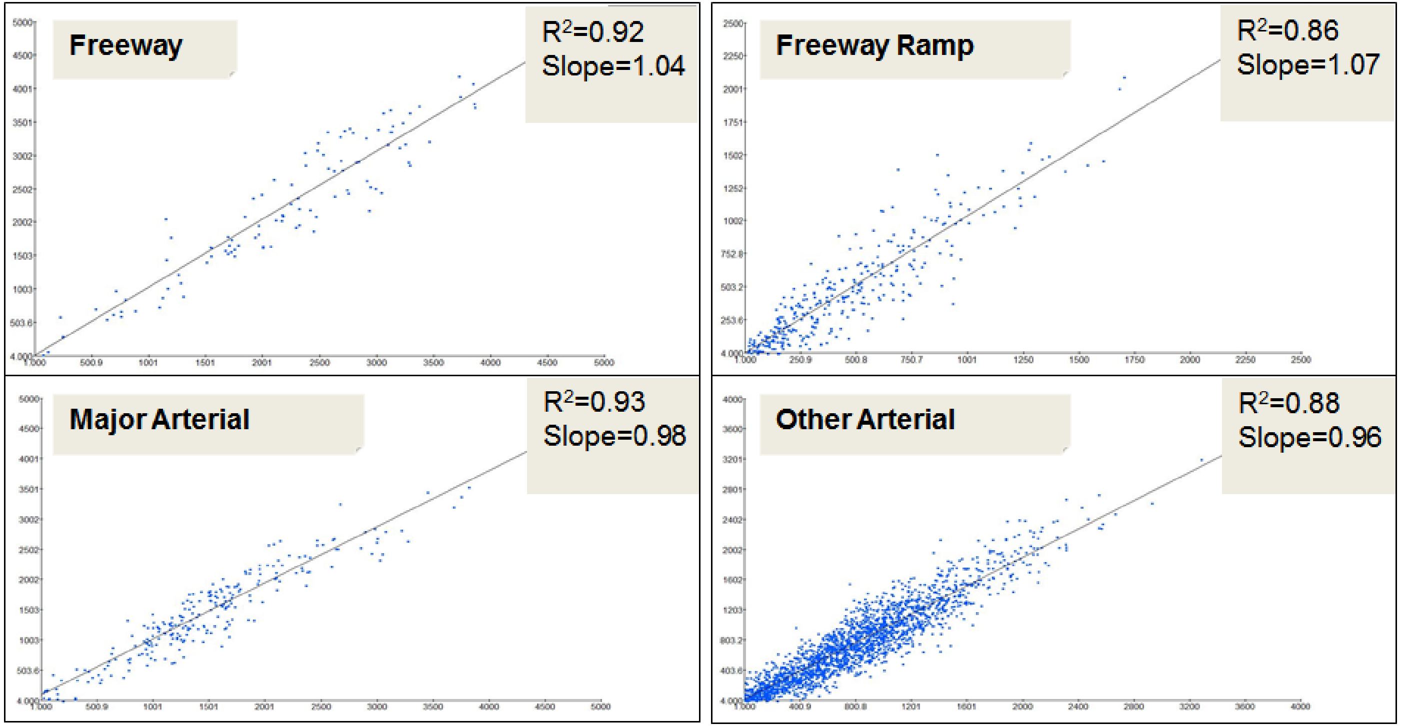
- Auto Link Cost= ptime + turn penalty cost + link distance cost
- Truck Cost= ptime + turn penalty cost + link truck cost



Select Link and O-D path analysis helps identify and adjust traffic demand at corridor level

Edmonton

Calibration Results

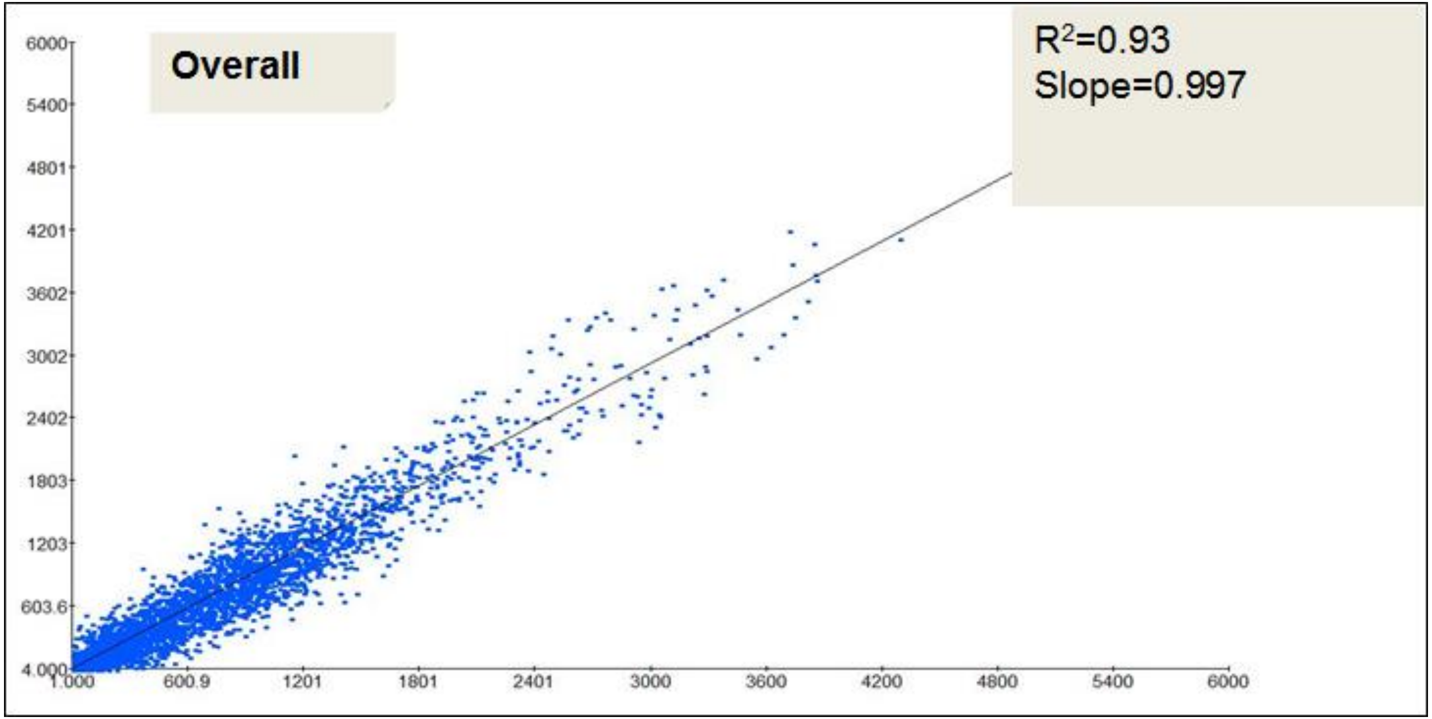


Link Auto Volume Comparison (16:00-17:00)

X Axis: Counts & Y Axis: Model Flow

Edmonton

Calibration Results



Link Auto Volume Comparison (16:00-17:00)

X Axis: Counts & Y Axis: Model Flow

Edmonton

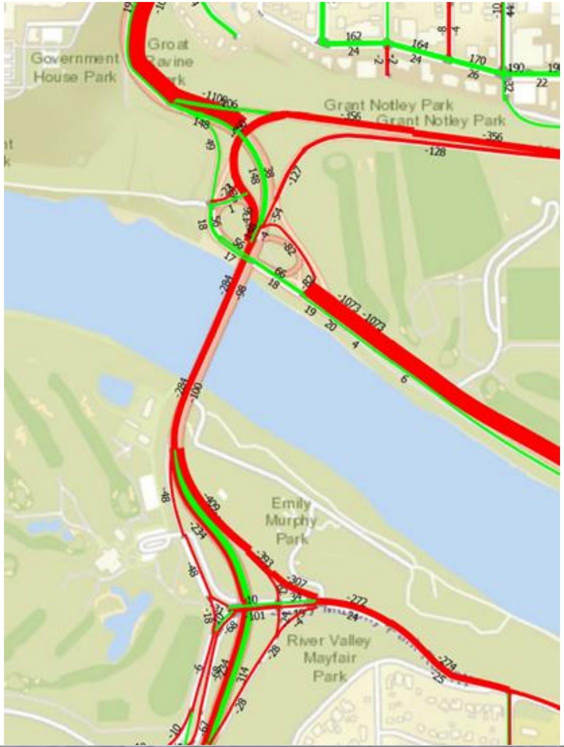
Case Study – Groat Road Rehabilitation Analysis

- Project Goal
  - Predict the traffic impact of Groat Rd rehab construction

- Study Tasks
  - Investigate traffic pattern shift
  - Estimate congestion at bottleneck
  - Compare travel time between construction and baseline

Edmonton

Case Study – Groat Road Rehabilitation Analysis



Construction

Baseline

Time and Resource

2015 PM City Wide DTA Model (built on top of Inner Ring Road model):

- Sub area demand preparation: ~3 months
- Counts import: ~3 months
- DTA network building: ~6 months
- Model calibration: ~3 months

~15 months (one FTE)

Computer Configuration

- Computer configuration
  - Intel® Xeon® CPU E5-2650 v4 (2.20GHz, 30MB) (2processors)
  - 1TB SATA and 256GB SSD
  - 128 GB RAM
  - NVIDIA M2000
  - Windows 7 Professional 64bit

- 8 min @ per iteration (about 50 iterations for 2015 PM, about 6.5 hr)

DTA Applications in Edmonton

- Freeway/Arterial Corridor Planning Analysis
- LRT and Transit Planning
- Neighborhood Traffic Calming
- Construction Detour (e.g. Road/Bridge Closure)
- Travel Paths for Micro-Simulation Models
- Traffic Demand Management
- Land Use Changes

Findings and Recommendations

- Staging development is an effective way for larger scale DTA (e.g. City wide) – knowledge, skills, confidence
- Calibration based on 15min traffic counts/ speed profile may be ideal, however it could be over calibrated due to counts noises
- Demand adjustment is useful, but only after error coding free of network, counts and calibration parameters (via iterative checking/debugging)
- Appropriate finer zone system and access locations are critical for DTA model development
- Automation tools greatly improve data quality and processing efficiency
- Traffic counts should be consistent (e.g. appropriate weekdays and months, avoid construction or special events)
- Dynameq is a very effective platform to model traffic of recurrent situation over the time.

Thank you.