Freight Day IV
Updating Edmonton’s Tour Based Commercial Vehicle Model

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February 10, 2015
Overview

- Introduction
- Freight Modelling Review
- Model Structure
- Method
- Results
- Conclusions
Introduction

Urban Weekday Vehicle Trips

- Commercial
- Personal

City of Edmonton, 2013
Introduction

Traffic Flow

Road Surface Conditions

Environmental Emissions

12%
Introduction

Edmonton Census Metropolitan Area (CMA)

- City of Edmonton
- St. Albert
- Sherwood Park
- Leduc County
- Strathcona County
- Sturgeon County
- Parkland County
Timeline

- 2001 CFS
- 2007 CVM
- 2012 Roadside Truck Survey
- 2014 Updated CVM

YOU ARE HERE
Problem Definition

1. City of Edmonton not confident in results of existing commercial vehicle model

2. Budget constraints hinder ability to collect an updated establishment-based survey to re-estimate tour-based model
Project Objectives

1. Develop a **cost effective** approach to upgrade the existing CVM

2. Conduct testing to evaluate a method for adjusting the existing CVM to reflect the 2012 Roadside Truck Survey
Freight Demand Modeling

Conventional Methods

- Growth Factor Methods
- Four Step Model

State-of-the-art Methods

- Supply Chain Model
- Tour-based Model
- Hybrid Approach
Calibration Techniques

Manual Search Methods
- Newton’s Method
- Secant Method
- Quadratic Approximation Methods
- Golden Section Method

Genetic Algorithm Approach

Additional Calibration Techniques
- Simplex-based Approach
- Gradient Approach
- Simulated Annealing Method
Existing Model

- CVM General Design Decisions
  - Vehicle Types
  - Land Use Types
  - Establishment Types
  - Time Periods
  - Tour Purpose
  - Stop Purpose
Existing Model

Aggregate Tour Generation

- Tour Generation
- Vehicle and Tour Purpose
- Tour Start
- Next Stop Purpose
- Next Stop Location
- Stop Duration

Microsimulation of Tours

EMME

JAVA

Iterative
CVM Micrsosimulation Process Example
CVM Microsimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
CVM Microsimulation Process Example

Tour Generation

Vehicle & Tour

Start Time

Next Stop Purpose

Next Stop Location

Stop Duration

Return

Next Stop Is At Establishment Location

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
CVM Microsimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 7:22 AM
CVM Microsimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 7:22 AM
  - Service stop

Tour Generation

Vehicle and Tour

Start Time

Next Stop Purpose

Service
Goods
Other

Next Stop Location

Stop Duration

Next Stop Is At Establishment Location

Return
Tour Generation

Vehicle and Tour

Start Time

Next Stop

Purpose

Service

Goods

Other

– Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
– Light vehicle; service tour
– Current time: 9:48 AM
  • Service, 1301 (SE Inner)

Stop Duration

Next Stop Location

Next Stop Is At Establishment Location
CVM Microsimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 9:48 AM
  - Service, 1301 (SE Inner)
  - Service stop
CVM Microsimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 11:21 AM
  - Service, 1301 (SE Inner)
  - Service, 1405 (Apartment)
CVM Microsimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 11:21 AM
  - Service, 1301 (SE Inner)
  - Service, 1405 (Apartment)
  - Other stop
CVM Micro simulation Process Example

Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 12:13 PM
  - Service, 1301 (SE Inner)
  - Service, 1405 (Apartment)
  - Other, 1412 (Banzai rest.)
CVM Microsimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 12:13 PM
  - Service, 1301 (SE Inner)
  - Service, 1405 (Apartment)
  - Other, 1412 (Banzai rest.)
  - Service stop
CVM Micrsosimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 4:20 PM
  • Service, 1301 (SE Inner)
  • Service, 1405 (Apartment)
  • Other, 1412 (Banzai rest.)
  • Service, 603 (Terra Losa)
CVM Micrsosimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time: 4:20 PM
  - Service, 1301 (SE Inner)
  - Service, 1405 (Apartment)
  - Other, 1412 (Banzai rest.)
  - Service, 603 (Terra Losa)
  - Return to establishment
CVM Micrsosimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time:
  - Service, 1301 (SE Inner)
  - Service, 1405 (Apartment)
  - Other, 1412 (Banzai rest.)
  - Service, 603 (Terra Losa)
  - Return to establishment, 1802
CVM Microsimulation Process Example

- Tour starting in zone 1802 (NW Suburb Industrial) AM Peak
- Light vehicle; service tour
- Current time:
  - Service, 1301 (SE Inner)
  - Service, 1405 (Apartment)
  - Other, 1412 (Banzai rest.)
  - Service, 603 (Terra Losa)
  - Return to establishment, 1802
- Tour starting in zone 501 (Central Fringe)
Existing Calibration Process

Aggregate Calibration Targets

- Ratio of employees that ship to total employees
- Daily tour generation
- Trips per tour
- Average trip length
- Destination sector factors: Proportions for trips to a given destination zone
- Intra-sector factors: Proportions for intra-sector trips
What is missing?

Aggregate Calibration Targets

- Ratio of employees that ship to total employees
- Daily tour generation
- Trips per tour
- Average trip length
- Destination sector factors: Proportions for trips to a given destination zone
- Intra-sector factors: Proportions for intra-sector trips

Road Counts
Count Location Selection
Shortcomings of Original CVM

Never validated against road counts

Relied primarily on aggregate targets which have changed since 2001
Comparison of Original Model to Counts

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Daily Truck Totals (veh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate</td>
<td>5619</td>
</tr>
<tr>
<td>Medium</td>
<td>35944</td>
</tr>
<tr>
<td>Heavy</td>
<td>51207</td>
</tr>
</tbody>
</table>

- Original
- Observed
# Comparison of Original Model to Counts

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Truck Totals (veh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>Original: 9947</td>
</tr>
<tr>
<td>PM</td>
<td>Original: 11082</td>
</tr>
<tr>
<td>OF</td>
<td>Original: 71741</td>
</tr>
<tr>
<td>24 Hour</td>
<td>Original: 92770</td>
</tr>
</tbody>
</table>

Legend:
- **Original**
- **Observed**
Recommendations to Improve Correspondence

- No change to tour generation model
- No change to tour start time model
- Re-calibrate tour purpose and vehicle type model
- Adjust next stop location model if necessary
Results

<table>
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<tr>
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</table>

Legend:
- **Original**
- **Adjusted**
- **Observed**
Results

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Truck Totals (veh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>9947 10114 11561</td>
</tr>
<tr>
<td>PM</td>
<td>11082 11168 10232</td>
</tr>
<tr>
<td>OF</td>
<td>71741 72200 66250</td>
</tr>
<tr>
<td>24 Hour</td>
<td>92770 93482 88043</td>
</tr>
</tbody>
</table>

- Original
- Adjusted
- Observed
### Results

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Vehicle Type</th>
<th>Original</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>Intermediate</td>
<td>5%</td>
<td>55%</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>55%</td>
<td>36%</td>
</tr>
<tr>
<td></td>
<td>Heavy</td>
<td>50%</td>
<td>59%</td>
</tr>
<tr>
<td>PM</td>
<td>Intermediate</td>
<td>5%</td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>32%</td>
<td>36%</td>
</tr>
<tr>
<td></td>
<td>Heavy</td>
<td>41%</td>
<td>45%</td>
</tr>
<tr>
<td>OF</td>
<td>Intermediate</td>
<td>0%</td>
<td>82%</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>27%</td>
<td>59%</td>
</tr>
<tr>
<td></td>
<td>Heavy</td>
<td>55%</td>
<td>64%</td>
</tr>
<tr>
<td>24 Hour</td>
<td>Intermediate</td>
<td>0%</td>
<td>82%</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>27%</td>
<td>55%</td>
</tr>
<tr>
<td></td>
<td>Heavy</td>
<td>55%</td>
<td>68%</td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>Measure</th>
<th>Target</th>
<th>Original</th>
<th>Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum of link volumes by vehicle type</td>
<td>Less than or equal to 15%</td>
<td>Intermediate 77%</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medium 85%</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heavy 17%</td>
<td>7%</td>
</tr>
<tr>
<td>Sum of link volumes</td>
<td>Less than or equal to 10%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>Percent of count locations where daily total model volumes within 40% of observed counts by vehicle type</td>
<td>Greater than or equal to 50% of locations</td>
<td>Intermediate 0%</td>
<td>82%</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>25%</td>
<td>55%</td>
</tr>
<tr>
<td></td>
<td>Heavy</td>
<td>55%</td>
<td>68%</td>
</tr>
</tbody>
</table>
Count Location Correspondence
AM Peak – Intermediate Trucks

![Graph showing truck counts across different locations with original, adjusted, and observed counts.](image-url)
Count Location Correspondence
AM Peak – Medium Trucks

Count Location		LocaBon

Truck Totals (veh)

Original
Adjusted
Observed
Count Location Correspondence
AM Peak – Heavy Trucks

![Graph showing the count location correspondence for AM Peak - Heavy Trucks. The graph compares the original, adjusted, and observed counts at various count locations.](image-url)
Limitations

- Adjustments limited to vehicle choice model
- No mechanism to improve site specific issues
- Highly dependent on quality of count data
- Not able to calibrate light trucks
Advantages

1. Calibration based on truck counts
2. More reliable results for the study year
3. Cost efficient
Future Research

Address site specific issues by adjusting next stop location model

Re-estimate models when an updated establishment-based survey is collected

Incorporate truck counts into calibration process
Relevance to Ontario?
Thank You

Questions?