Ontario Commercial Vehicle Survey – Use of GIS for Data Collection, Processing, Analyses and Dissemination

Presented at

FREIGHT DEMAND MODELLING: TOOLS FOR PUBLIC SECTOR DECISION MAKING

September 26, 2006

Presenter: Selva Sureshan
Discussant: Rob Tardif
Ontario Ministry of Transportation
National Roadside Study/Commercial Vehicle Survey

- Collaborative effort between the provinces and the Federal Government
- Conducted every 5-6 years
- Major National Survey in 1999, followed by smaller surveys in 2000 and 2001 in Ontario only
- Roadside Truck Driver Interview to collect trip route, commodity, and vehicle information
- Interviews conducted at 250 locations on highways and major international border crossings across Canada.
- 2005/2007 Survey Currently Underway
Ontario Commercial Vehicle Survey

- CVS database contains:
  - 38,700 records Collected from 130 Directional sites on Ontario Highways and Border Crossings
  - 2850 records collected in other provinces that had travelled on Ontario Highways
  - Total weekly trips represented – 646,000

- A supplementary database of 1689 records from 12 sites from Intermodal Terminals, including Toronto Pearson International Airport
DATA COLLECTION
Data Collected

Up to 100 pieces of information collected, including:

• Trip
  • trip stops, inter-provincial and international borders crossed

• Commodity
  • name, weight, dangerous goods, origin and destination

• Vehicle
  • type, body style, number of axles, weight and spacing, capacity utilization

• Company
  • Name, license plate jurisdiction, base city, for-hire/private

• Driver
  • base city, driver training, experience
Details of Trip Information

• Trip Origin and Destination
• Stop immediately prior to the survey
• Stop immediately after the survey
• Provincial entry and Exit Points
• International border entry and exit points
  ➢ up to two entry and two exit points
• Survey Location
• Highways used for the trip

Up to 11 geographic points directly related to the trip
Other Data Related to Trip Making

• Commodity Origin and Destination
• Commodity Name
• Carrier Data
  • Name
  • Company Base
  • Type of Business (for hire, private)
• Driver Base
TRIP DATA REVIEW AND CLEANSING
Review of Individual Survey Records

- Each Survey Record was reviewed individually
- GISDK based TransCAD application was used to review routes and make corrections
- Additional fields are calculated once the routing is accepted
  - Distance travelled in each province and state
  - Points of Interest passed
Why is it Important to Get the Route Correct?

A survey is a sample for all the survey stations along the trip route.

The expansion factor of a record is affected by the number of survey stations passed along the trip.
Data Review Panel

MINISTRY OF TRANSPORTATION

Ontario
MINISTRY OF TRANSPORTATION
Common Problems

Duplicate Name Errors
Jurisdiction Errors
Routing Errors
DATA ANALYSIS AND ASSIGNMENTS
Points on Interest (POI)

- Any point on the highway network
  - All NRS survey sites across Canada
  - All international and Interprovincial Crossings
  - Other points

- Can be added as required

- Currently more than 1000 directional POIs Across Canada and the U.S.
Current Points of Interest
MTO Model

- No zone system
- Tour Based Assignment
- Each trip is broken down into sub-trips
- Network nodes closest to the trip-ends act as temporary centroids
- Trip, Commodity Weight, Value assignments
Trip Assignment Results
Data Retrieval Screen

Selection Condition referring to “Select Link Point”
FEATURES OF CVS REPORTING SYSTEM

• Application developed using ArcGIS, Crystal Reports, and Adobe Acrobat

• Creates a 3 or 4 page predefined report containing Charts, graphs and a thematic map of Ontario

• Output is in Acrobat format that can be distributed electronically
CVS Reporting System

Selected Locations Highlighted
Types of Reports

1. Data Collection Site Report
2. General Point of Interest Report
3. Area Report
4. Corridor Report
5. Custom Report
CVS Reporting System – Report Layout 2

DRYDEN - WEST BOUND TRAFFIC

COMMODITY COMPOSITION

VEHICLE CONFIGURATION

OTHER COMMERCIAL TRAFFIC PROPERTIES

LIFT AXLES

NUMBER OF AXLES

AVERAGE EQUIVALENT SINGLE AXLE LOADINGS (ESALs)

LEVEL OF UTILIZATION BY VEHICLE CONFIGURATION

MINISTRY OF TRANSPORTATION

Ontario

MINISTRY OF TRANSPORTATION
LESSONS LEARNED and PROCESS IMPROVEMENTS
“Insufficient Routing information Collected adds significant Delays to Data Processing”

Measures Taken to Mitigate this Shortcoming

• 2006 National Roadside Study Survey Software Integrates Routing Component using Microsoft MapPoint

• Address Level information is Collected to accurately project the trip route

• Built-in Validity checks to Ensure Core Route Data is Collected – e.g. Border Crossings for International Trips
2005/2007 NRS Survey Software
Address Locator Screen
2005/2007 NRS Survey Software
Review of Highways Used

1. Ask the driver some of the highways they took and confirm with this list of highways. NOTE: Trucker might list the highways out of order.

   Total Distance: 304.3 km
   - 89 km - HWY 11A (5.0 km)
   - 59 km - HWY 2 (84 km)
   - At 37.5 km - HWY 403 (102.9 km)
   - At 149.5 km - HWY 401 (51.5 km)
   - At 192.8 km - HWY 402 (102.8 km)
   - At 296.4 km - Entering Michigan
   - At 296.4 km - I-69 (5.5 km)
   - At 300.9 km - I-94 (55.3 km)

2. To confirm details in major cities on the corridor (Montreal, Ottawa, Toronto) zoom into these cities and verify the route with the driver.

   Ok

   Fix Route
Other Innovative Truck Monitoring Methods Under Development

Use of Truck Mounted GPS to:

- Monitor Urban Truck Movement Patterns
- Monitor Highway Congestion and Incident Detection
- Estimate Cost of Incidents
- Learn Truck Origin Destination Patterns
- Derive Commodity Flow Patterns
- Report Near Real-Time Transit Times at International Border Crossings (Initiative by Transport Canada – Ontario Region)
Advantages of GPS Technology

Continuously Monitor Truck’s Location – record the position every few seconds

O-D Data for Many Trips for the Same Truck Can be Collected Compared to a Single Trip From a Survey

Data Not Limited to Trucks – Useful to Analyse General Traffic Conditions
Single Day Coverage of GPS Equipped Trucks - 2005
Path of a Vehicle in a Single Day

Consistent Recurring Delays

Trip Stops

Consistent Recurring Delays
### Trip Report

#### Vehicle Detail

**Unit:** 3772  
**Date:** 2005-12-01

<table>
<thead>
<tr>
<th>State</th>
<th>Location</th>
<th>Arrival - Departure</th>
<th>Distance (km)</th>
<th>Stop Time (hh:mm)</th>
<th>Avg Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>Palmer (BURLINGTON)</td>
<td>19:14 - 09:22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>QE/W</td>
<td>1.9</td>
<td></td>
<td>14:08</td>
<td>64.4</td>
</tr>
<tr>
<td>ON</td>
<td>QE/W</td>
<td>32.9</td>
<td></td>
<td></td>
<td>84.5</td>
</tr>
<tr>
<td>ON</td>
<td>427</td>
<td>7.8</td>
<td></td>
<td></td>
<td>102.4</td>
</tr>
<tr>
<td>ON</td>
<td>401</td>
<td>11.4</td>
<td></td>
<td></td>
<td>61.8</td>
</tr>
<tr>
<td>ON</td>
<td>Downsvill (NORTH YORK)</td>
<td>10:01 - 10:02</td>
<td>0:01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>North Park (NORTH YORK)</td>
<td>10:02 - 18:34</td>
<td>8:31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ON</td>
<td>401</td>
<td>17.2</td>
<td></td>
<td></td>
<td>79.7</td>
</tr>
<tr>
<td>ON</td>
<td>403</td>
<td>19.9</td>
<td></td>
<td></td>
<td>97.9</td>
</tr>
<tr>
<td>ON</td>
<td>Dundas ST E</td>
<td>4.4</td>
<td></td>
<td></td>
<td>60.8</td>
</tr>
<tr>
<td>ON</td>
<td>Dundas ST W</td>
<td>8.5</td>
<td></td>
<td></td>
<td>69.7</td>
</tr>
<tr>
<td>ON</td>
<td>Dundas ST</td>
<td>4.0</td>
<td></td>
<td></td>
<td>59.8</td>
</tr>
<tr>
<td>ON</td>
<td>Walkers Line</td>
<td>3.5</td>
<td></td>
<td></td>
<td>41.9</td>
</tr>
<tr>
<td>ON</td>
<td>Palmer (BURLINGTON)</td>
<td>19:18 -</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Trip Summary Detail**

- **Total Distance:** 111.4 km  
- **Total Time:** 22:40  
- **Average Speed:** 80.5 km/h
## Peace Into USA

<table>
<thead>
<tr>
<th>Start Date</th>
<th>End Date</th>
<th>Stop Time</th>
<th>Crossing Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-10-06 03:27 PM</td>
<td>2005-10-06 03:31 PM</td>
<td>0</td>
<td>4:2</td>
</tr>
<tr>
<td>2005-10-06 03:39 PM</td>
<td>2005-10-06 03:43 PM</td>
<td>0</td>
<td>17:30</td>
</tr>
<tr>
<td>2005-10-06 03:56 PM</td>
<td>2005-10-06 04:00 PM</td>
<td>0</td>
<td>4:55</td>
</tr>
<tr>
<td>2005-10-06 03:00 PM</td>
<td>2005-10-06 03:04 PM</td>
<td>0</td>
<td>2:20</td>
</tr>
<tr>
<td>2005-10-06 02:04 PM</td>
<td>2005-10-06 02:08 PM</td>
<td>0</td>
<td>57:25</td>
</tr>
<tr>
<td>2005-10-06 02:41 PM</td>
<td>2005-10-06 02:45 PM</td>
<td>0</td>
<td>3:32</td>
</tr>
<tr>
<td>2005-10-06 02:35 PM</td>
<td>2005-10-06 02:43 PM</td>
<td>0</td>
<td>4:02</td>
</tr>
<tr>
<td>2005-10-06 02:17 PM</td>
<td>2005-10-06 02:20 PM</td>
<td>0</td>
<td>11:20</td>
</tr>
<tr>
<td>2005-10-06 02:20 PM</td>
<td>2005-10-06 02:23 PM</td>
<td>0</td>
<td>8:37</td>
</tr>
<tr>
<td>2005-10-06 01:36 PM</td>
<td>2005-10-06 02:10 PM</td>
<td>0</td>
<td>34:55</td>
</tr>
<tr>
<td>2005-10-06 02:00 PM</td>
<td>2005-10-06 02:05 PM</td>
<td>0</td>
<td>5:40</td>
</tr>
<tr>
<td>2005-10-06 01:33 PM</td>
<td>2005-10-06 01:55 PM</td>
<td>14:3</td>
<td>7:85</td>
</tr>
<tr>
<td>2005-10-06 01:40 PM</td>
<td>2005-10-06 01:54 PM</td>
<td>7.5</td>
<td>9:50</td>
</tr>
<tr>
<td>2005-10-06 01:34 PM</td>
<td>2005-10-06 01:35 PM</td>
<td>0</td>
<td>4:3</td>
</tr>
<tr>
<td>2005-10-06 01:50 PM</td>
<td>2005-10-06 01:52 PM</td>
<td>0</td>
<td>9:02</td>
</tr>
<tr>
<td>2005-10-06 12:35 PM</td>
<td>2005-10-06 12:35 PM</td>
<td>0</td>
<td>30:55</td>
</tr>
<tr>
<td>2005-10-06 10:53 PM</td>
<td>2005-10-06 10:53 PM</td>
<td>0</td>
<td>2236.07</td>
</tr>
<tr>
<td>2005-10-06 11:23 PM</td>
<td>2005-10-06 11:23 PM</td>
<td>0</td>
<td>27.3</td>
</tr>
<tr>
<td>2005-10-06 10:55 AM</td>
<td>2005-10-06 11:12 AM</td>
<td>0</td>
<td>17:35</td>
</tr>
<tr>
<td>2005-10-06 10:57 AM</td>
<td>2005-10-06 11:10 AM</td>
<td>0</td>
<td>12:82</td>
</tr>
<tr>
<td>2005-10-06 10:28 AM</td>
<td>2005-10-06 11:32 AM</td>
<td>0</td>
<td>4.6</td>
</tr>
<tr>
<td>2005-10-06 09:02 AM</td>
<td>2005-10-06 10:05 AM</td>
<td>0</td>
<td>15:30</td>
</tr>
<tr>
<td>2005-10-06 10:03 AM</td>
<td>2005-10-06 11:08 AM</td>
<td>0</td>
<td>4:32</td>
</tr>
<tr>
<td>2005-10-06 08:41 AM</td>
<td>2005-10-06 09:42 AM</td>
<td>0</td>
<td>2.1</td>
</tr>
<tr>
<td>2005-10-06 08:57 AM</td>
<td>2005-10-06 09:59 AM</td>
<td>0</td>
<td>22.87</td>
</tr>
<tr>
<td>2005-10-05 08:41 AM</td>
<td>2005-10-05 09:41 AM</td>
<td>0</td>
<td>30.6</td>
</tr>
<tr>
<td>2005-10-06 08:40 AM</td>
<td>2005-10-06 09:40 AM</td>
<td>0</td>
<td>24.40</td>
</tr>
</tbody>
</table>
**HOV Monitoring**

**Highway 403 AM Peak Hour Eastbound**

**Highway 404 AM Peak Hour Southbound**

**Hwy 403 Truck Travel Times**

<table>
<thead>
<tr>
<th>Period</th>
<th>Sample</th>
<th>Travel Time Minutes</th>
<th>Time Savings in Min. Over Pre HOV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre - Implementation</td>
<td>116</td>
<td>23.9</td>
<td></td>
</tr>
<tr>
<td>Immediately After</td>
<td>67</td>
<td>21.8</td>
<td>2.1</td>
</tr>
<tr>
<td>One month Later</td>
<td>186</td>
<td>13.8</td>
<td>10.1</td>
</tr>
</tbody>
</table>
Ontario has been involved in roadside data collection for 40 years.

**Primary Objective:**
Increase awareness then prioritize Freight infrastructure investments.

Support $2 B annual investment in highway maintenance and expansion.

Time interval 5 years, 2 years of data collection
- Costs: Intercept surveys $5 million, Traffic Counts/WIM +$1 million
- Coverage 50% urban truck trips, 70% inter-city VKT’s & trips
- Enables project and link level analysis.
- Promotes multi-modal Freight Model development
Discussant: Rob Tardif

Data Gaps:
• Lacks robust urban activity, limited service vehicles
• Limited knowledge of hour of day usage on each link
• Unable to address congestion monitoring

Future of Freight Data Collection in Ontario
• Roadside surveys are intrusive, depends on Enforcement, costly, timeliness of data.
• Envision a reduced focus on roadside surveys.
• GPS is the wave of the future for non-regulatory purposes
• In 2003, monitored 2000 trucks daily, now +20,000 in Ontario
• Ability to monitor 40,000 in the U.S. and Canada
• Every 400 yards, knowledge of location, time stamp, routes, speed, fuel consumption, hard brake activity.
• Exceptional data on: congestion, route mitigation, link performance/bottlenecks, weaving, safety issues, HOV/GPL evaluation, impact of HOV on truck travel, dwell time vs. travel time.
Discussant: Rob Tardif

Future of Freight Data Collection in Ontario – Continued

- Access to 3rd party GPS data is a privilege
- Planners must respect carrier privacy
- Demonstrate benefits to carriers & their associations
- Challenges exist in linking Roadside/GPS/WIM/ATR data

Limitations:
- Huge volume of data forms data management issues
- No software to support GPS data processing & dissemination
- GPS data lacks information related to:
  - Commodity, utilization, empty moves, truck type, carrier name, carrier type, licence plate, axle weights & spacing.
- GPS sample may form a biased sample.
- Calibration remains critical and even more complex.
- Access in the long-term remains unknown
- Regulatory efforts to deploy system wide remain uncertain.