Urban Traffic Data Integration: A Case Study for Edmonton

Presenter: Dr. Tony Qiu, University of Alberta

Co-authors:
Md Tazul, Gary Liu, Michael Ge, University of Alberta
Dr. Stevanus A. Tjandra, City of Edmonton
Agenda

Project Background

Traffic Data Integration (TDI)

Edmonton TDI Initiative

Five Year Plan for Edmonton TDI

Experiences and Lessons
Why we need TDI?

- Data driven decision making procedure.
- Data are too valuable to only use once!
- Management of transportation system **CANNOT** be done without knowledge of its performance!
## Traffic Data Sources

<table>
<thead>
<tr>
<th>Data Sources</th>
<th>Primary Data Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Flow Data</td>
<td>Volume, Speed, Occupancy, Vehicle classification, Queue length, Vehicle trajectories, timestamp, location</td>
</tr>
<tr>
<td>Traffic Control Data</td>
<td>Begin time, End time, Location, Up/downstream offsets, time of pre-emptions, cycle length</td>
</tr>
<tr>
<td>Incident Management Data</td>
<td>Location, Begin, notification, dispatch, arrive, clear, depart times, vehicle type, response type, date, time, lanes/shoulders, blocked</td>
</tr>
<tr>
<td>Transit Data</td>
<td>Vehicle, boarding (by time and location), Station origin and destination (O/D), Para transit O/D, route number, time of advisory, route, segments taken</td>
</tr>
<tr>
<td>Collision Data</td>
<td>Location, Time, Vehicle type, Cause, etc.</td>
</tr>
<tr>
<td>Environmental Weather Data</td>
<td>Time, Location, Pollutant, Concentrations, Wind conditions, Precipitation, Temperature, Wind conditions</td>
</tr>
<tr>
<td>Other Data</td>
<td>Special case; pertains to all location references Vehicle ID, Segment, Location, Travel time VMS location, Time, Mug content Time/date, O/D, Route, Segments, Estimated travel time</td>
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</tbody>
</table>
A data management process aims at accessing and utilizing database by a combination of data from different sources.

It require a transformation of data sets in a way that makes cross data set applications feasible.

- Temporal data integration,
- Spatial data integration
- Semantic data integration
- Topical data integration
- Procedural data integration
- Functional data integration

(Reference: Vladimir Livshits, TRB 91st Annual Meeting)
TDI Planning Steps

- Step I (user) – Gather request from users, scan for resources, establish context, and identify critical information;
- Step II (data) – Prioritize resources, analyze pertinent information and identify information gaps;
- Step III (system) – Synthesize best information and recommend next steps for implementation
TDI Planning Logic

User
(request/feedback)

Data
(priority/quality)

System
(function/deploy)

7/4/2012
Inadequate knowledge about the existence of various data and their availability,

Lack of linkages with other databases resulting in duplicate data collection, processing and management,

No standardized method for the specific identification of attributes across data sources,

Lack of communication among stakeholders of important changes to the data, and

Lack of access to other data systems

Existing Situation in Edmonton

Data Silos

Modified from the original picture shown in http://blogs.sun.com/bblfish/entry/business_model_for_open_distributed
Traffic Data Coordination Committee (TDCC)

Traffic Data Coordination Committee

Policy direction, strategic and tactical needs

Recommended operational needs and actions (e.g., standardized format, critical data, data collection and analysis procedures)

Program oversight

Recommended Integrated System and Five-Year Plan

Program oversight

University of Alberta

Traffic Data Integration Project
Proposed TDI Plan

Spatial Business Intelligence Framework

Stakeholders

- Automated Enforcement (Intersection Safety Cameras and Photo Radar Cameras)
  - Enforcement durations
  - Traffic counts
  - Offence statistics
  - Issued tickets statistics
  - Locations

- Traffic Count Management (TCM)
  - Traffic volume
  - Turning movement counts
  - Speed surveys

- Motor Vehicle Collision Information System (MVCIS)

- Spatial Land Inventory Management (SLIM)

- Traffic Complaints System (Enterprise Solution 2011)

- Transportation Operations

- Roadway collisions
- Roadway inventory

- Speed & traffic complaints
- Road conditions
- Roadway maintenance

- Environment Canada
  - Weather conditions

- Federal Census
  - Demographic statistics
  - Manned enforcement
  - Impaired driving
  - Crime statistics
  - Shift schedules

- Edmonton Police Service
  - Accidents/incidents

- Transit
  - Bus Stops & routes
  - Passenger counts

- Transit Safety & Security
What is the overall transportation status (collision, road class, traffic flow) by road segment, boundary (neighborhood, community)?

What are the impacts of the community-based engineering initiatives?

What is the turning movement and volume history by vehicle classification?

Are the traffic signal timing plans optimal - do traffic turning patterns match signal timing plans?

What is the actual flow of traffic (micro simulation in 10 minute time bins of traffic volume and speed)

What is the collision rate per million vehicles entering the intersection, midblock?

What are the top collision locations and collision rates involving a transit vehicle?

What are the speeding hot spots by road classification/community and in ranked order?

What is the correlation between speed and collisions by roadway classification and community?
Business Question Survey

Number of Business Questions per Data Source
Integrating Business Intelligence and Geospatial

Business Intelligence Tool

Spatial Tool

Oracle Spatial

Spatial Queries
TDI Applications

- Traffic Safety System Function
  - Collision rate determination at intersections, midblock and access points
  - Predominant collision cause study
  - Speeding hotspots identification and predictions

- Traffic Operation System Function
  - More accurate traffic flow studies
  - Congestion location identification
  - Arterial performance Measurement
TDI Applications

- Transit System Function
  - Transit route planning
  - Accidents study
  - Passenger volume study

- Transportation Planning Function
  - Sustainable transportation and land use planning

SBI (Spatial Business Intelligence)

- **Operation:**
  - TCM-N
  - TCM-V
  - TCM-G
  - Traffic control
  - Loop detector

- **Safety:**
  - MVCIS
  - AMIS

- **Planning:**
  - AADT from-
    - TCM-N
    - TCM-V
    - TCM-G
    - Loop detector
    - HHTS Data

- **Others:**
  - Auto enforcement
  - Police enforcement
  - Census
  - Traffic complaint
  - RWIS
Priority of TDI Deployment

Three criterions

- Requested function for general public

- Requested function for multiple stakeholders within City of Edmonton

- Requested function for one single stakeholder within City of Edmonton
**Roadmap**

**Take Aim Before You Shoot:**
Identify integrated data requirement and priority through business questions

**Know your capacity:**
- Reshaping, not reinventing, the wheel
- Available data integration platform
- Available resources (Business and IT)

**Create plan and working pilot/prototype (start with small but meaningful set of data)**

**Feasible plan and Working results**

**Result**

Identify 85 Business Questions from the stakeholders with their priority level: 48 High, 29 Medium, 3 Low, 5 N/A

- Business Intelligence (BI) platform: SAP Business Objects
- Spatial data warehouse, GIS platform: SLIM, Intergraph GeoMedia
- IT and Business leader and user support

Pilot data: Collision, Traffic flow, and roadway attributes

- Five year plan for data integration
- Integrated BI for above three data sets:
  - Answer 28% (24/85) business questions with 42% (20/48) high priority questions
  - enable business users to create cross-section report and perform data analysis
  - Text and chart report in BI; map interface in SLIM
- User training for integrated BI system
- Total project cost:
Prioritized SLIM data

Business Questions from the data stakeholders

- Roadway inventory data (SLIM)
- Collision Data (MVCIS)
- Traffic Flow: Speed, road segment volume, intersection turning movement count (TCM)

Create spatial coordinate

Create spatial data integrator

GeoMedia

Integrated Data Warehouse

BusinessObjects:
- WeBi
- Xcelsius
- Crystal Report

TDI Project – Phase 1
Demo Dashboard of Cross-sectional Statistics
### Data set and integration methods
- Improve the integration method
- Improve data update from MVCIS to SLIM
- Include SLIM street intersection attributes
- Include EPS subdivision definition in SLIM Data Warehouse
- Add one new data set; options:
  - automated enforcement
  - transit
  - traffic flow data from VDS
  - census

### Spatial Business Intelligence Application
Expand the use of BI Toolset (visualization, dashboarding, and scheduling):
- Xcelsius Dashboard with Dynamic Data Source connection; Static Map Interface
- WeBi Reports with Static Map Interface
- Crystal Reports with Static Map Interface
- InfoView as Report Portal – establish a Folder structure within InfoView to allow access to all TDCC reports via a common portal
- Report Scheduling – ability to schedule reports to run

### Research & Exploration
- Explore Predictive Analytics tool
- Improved use of multiple Universes with BOE Upgrade
- Implementation of LRS to Traffic flow and collision data
- Traffic and Crime map (collaboration with EPS)
- Refine Year 3 to 5 plan

- User training for the integrated SBI system.

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# Proposed TDI Project – Year 2
<table>
<thead>
<tr>
<th>Year and time frame</th>
<th>Data set and integration methods</th>
<th>Spatial Business Intelligence Application</th>
<th>Research &amp; Exploration</th>
</tr>
</thead>
</table>
| Year 3: July 1, 2013 – June 30, 2014| ▪ Optimize data integration using LRS  
▪ Add one new data set; options:  
  ✓ Unselected data in Year 2  
  ✓ RWIS  
  ✓ roadway maintenance | ▪ 3rd Party tool for bidirectional integration BI with Spatial  
▪ Predictive Analytics  
▪ Traffic and Crime map (collaboration with EPS) | ▪ Explore “Real Time” data options  
▪ SLIM Map Interface Interactive – Spatial Tool Analysis  
▪ Feasibility study for the creation of Business Intelligence Competency Centre (BICC) |
|                                    | ▪ User training for the integrated SBI system                                                   |                                                                                                                                                                     |                                                                                        |
| Year 4: July 1, 2014 – June 30, 2015| ▪ Add one new data set; options:  
  ✓ Unselected data in Year 3  
  ✓ Public complaints  
  ✓ Police data (enforcement) | ▪ Real Time data                                                                                           | ▪ Add spatial capabilities into Predictive Analysis/Modeling functionality          |
|                                    | ▪ Use the Office of Traffic Safety for Piloting Business Intelligence Competency Centre (BICC) |                                                                                                                                                                     |                                                                                        |
|                                    | ▪ User training for the integrated SBI system                                                   |                                                                                                                                                                     |                                                                                        |
| Year 5: July 1, 2015 – June 30, 2016| ▪ Add one new data set; options:  
  ✓ Unselected data in Year 4  
  ✓ Transit security | ▪ Predictive analytics with interactive mapping                                                         | ▪ Explore Predictive Analytics with real-time data                                    |
|                                    | ▪ Establishment of BICC  
▪ User training for the integrated SBI system                                                        |                                                                                                                                                                     |                                                                                        |

**Proposed TDI Plan – Year 3 to 5**
Experiences and Lessons

- Begin with few data sources, and then more, ……
- Provide data through the GIS tool – visualization
- Standardization – term, location reference, ……
- Save raw data, with high resolution
- Implement data quality control and quality assurance
- Create adequate documentation of system and metadata
- Collaboration
- Work flowchart
- ……
Question?

Dr. Tony Qiu: tony.qiu@ualberta.ca
Dr. Stevanus Tjandra, stevanus.tjandra@edmonton.ca