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City of Edmonton Office of Traffic Safety
City of Edmonton Office of Traffic Safety

Performance Measurement and Traffic Safety Problem

Business Intelligence (BI) System for Traffic Data Integration

Integrated Data Analysis

BI, KPI and Predictive Analytics
Established in 2006 as a result of Mayor Traffic Safety Task Force

World urbanization - UN report 2009:

<table>
<thead>
<tr>
<th>Year</th>
<th>Urban Population</th>
<th>Rural Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>3.4 billion</td>
<td>3.4 billion</td>
</tr>
<tr>
<td>2050</td>
<td>6.3 billion</td>
<td>2.9 billion</td>
</tr>
</tbody>
</table>

The OTS will reduce the prevalence of fatal, injury, and property damage collisions through the 4 E’s of traffic safety (Engineering, Education, Enforcement, and Evaluation) by improving:

- urban traffic safety engineering
- road user behaviour
- speed management and
- data, business intelligence and analytics

Measuring Performances

- “You Can’t Manage What You Don’t Measure”
- “What Gets Measured Gets Done” (Peter Drucker)

Strategic Statement

Key Result and Performance Indicators (KRIs and KPIs)

Data + Analytics
## KPI Level I and II

### Level I

#### Intersection Collisions per 1000 Population

<table>
<thead>
<tr>
<th>Year</th>
<th>2010 (Jan - Dec)</th>
<th>2011 (Jan - Dec)</th>
<th>2012 (Jan - Dec)</th>
<th>2013 (Jan - Dec)</th>
<th>2014 (Jan - Apr)</th>
</tr>
</thead>
<tbody>
<tr>
<td># Collisions</td>
<td>13,499</td>
<td>12,412</td>
<td>12,673</td>
<td>13,671</td>
<td>4,268</td>
</tr>
<tr>
<td>Population</td>
<td>793,000</td>
<td>812,201</td>
<td>817,498</td>
<td>835,000</td>
<td>853,000</td>
</tr>
<tr>
<td>Collisions per 1000 Population Target</td>
<td>N/A</td>
<td>16.6</td>
<td>16.2</td>
<td>15.8</td>
<td>15.5</td>
</tr>
<tr>
<td>Collisions per 1000 Population Actual</td>
<td>17.02</td>
<td>15.28</td>
<td>15.50</td>
<td>16.37</td>
<td>15.01</td>
</tr>
</tbody>
</table>

#### Injuries per 1000 Population

<table>
<thead>
<tr>
<th>Year</th>
<th>2010 (Jan - Dec)</th>
<th>2011 (Jan - Dec)</th>
<th>2012 (Jan - Dec)</th>
<th>2013 (Jan - Dec)</th>
<th>2014 (Jan - Apr)</th>
</tr>
</thead>
<tbody>
<tr>
<td># Injuries</td>
<td>4,910</td>
<td>4,446</td>
<td>4,338</td>
<td>4,123</td>
<td>972</td>
</tr>
<tr>
<td>Population</td>
<td>793,000</td>
<td>812,201</td>
<td>817,498</td>
<td>835,000</td>
<td>853,000</td>
</tr>
<tr>
<td>Injuries per 1000 Population Target</td>
<td>N/A</td>
<td>6.6</td>
<td>6.6</td>
<td>6.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Injuries per 1000 Population Actual</td>
<td>6.19</td>
<td>5.47</td>
<td>5.31</td>
<td>4.94</td>
<td>3.42</td>
</tr>
</tbody>
</table>

### Level II

#### # Serious (Major) Injuries

<table>
<thead>
<tr>
<th>Year</th>
<th>2010 (Jan - Dec)</th>
<th>2011 (Jan - Dec)</th>
<th>2012 (Jan - Dec)</th>
<th>2013 (Jan - Dec)</th>
<th>2014 (Jan - Apr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Target</td>
<td>476</td>
<td>451</td>
<td>426</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td>491</td>
<td>445</td>
<td>517</td>
<td>437</td>
<td>95</td>
</tr>
</tbody>
</table>

#### # Fatalities

<table>
<thead>
<tr>
<th>Year</th>
<th>2010 (Jan - Dec)</th>
<th>2011 (Jan - Dec)</th>
<th>2012 (Jan - Dec)</th>
<th>2013 (Jan - Dec)</th>
<th>2014 (Jan - Apr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Target</td>
<td>28</td>
<td>26</td>
<td>25</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Actual</td>
<td>27</td>
<td>22</td>
<td>27</td>
<td>23</td>
<td>5</td>
</tr>
</tbody>
</table>
Traffic Safety: A Multidimensional Problem

**Roadway Engineering**
- Geometric design: curves, slope, lane width, etc.
- Non-reflective paint
- Speed bump
- Road physical conditions

**Regulation**
- Lighting
- Traffic signs
- Speed limit
- Seat belt

**Road User Behaviour**
- Alertness: alcohol/drug, fatigue, health
- Attention: cell phone, music
- Driving skill/training
- Age
- Gender

**Education**
- Distracted Driving Law
- Community Program to promote traffic safety
- Seat belt

**Vehicle**
- Brake malfunction
- Vehicle safety performance: crashworthiness, aggressivity.
- Side-view mirrors
- Dynamic Message Sign (DMS)

**Nature**
- Visibility Index
- Animal crossing
- Visibility of windows
- Sun glare
- Check Stop
- Presence of enforcement officers
- Enforcement officers
- Demand vs. capacity: road congestion, required # road connections to meet the traffic growth

**Traffic safety**
- Speeding
- Driving decision
- Presence of passengers
- Socio-economic level
- Enforcement camera: intersection, road segment
- Geometric design: curves, slope, lane width, etc.
Weather Impacts on Traffic Safety: Trends and Patterns
Repeat Violators

Traffic Safety - Road User Behaviour
Automated Enforcement Issued Tickets - Summary Report

Data from Jan 2013 to Jun 2014

Top 10 Violators

Alberita License Plates

<table>
<thead>
<tr>
<th>License Plate</th>
<th>Violation Date</th>
<th>Violation Time</th>
<th>Automated Enforcement Type</th>
<th>Site Name</th>
<th>Speed Limit (km/h)</th>
<th>Trigger Speed (km/h)</th>
<th>Speed</th>
<th>Difference from Speed Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sat, Oct 26, 2013</td>
<td>11:53:04 AM</td>
<td>ISD</td>
<td>Yellowhead Trail at 215 St EB</td>
<td>100</td>
<td>115</td>
<td>131</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Sun, Oct 13, 2013</td>
<td>11:43:48 AM</td>
<td>ISD</td>
<td>Dragon Cam</td>
<td>100</td>
<td>115</td>
<td>136</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Wed, Oct 2, 2013</td>
<td>3:35:39 PM</td>
<td>ISD</td>
<td>82 St @ 153 Ave NB</td>
<td>45</td>
<td>75</td>
<td>37</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Mon, Sep 30, 2013</td>
<td>1:13:28 PM</td>
<td>ISD</td>
<td>Yellowhead Tr @ 107 St WB</td>
<td>70</td>
<td>85</td>
<td>96</td>
<td>16</td>
</tr>
</tbody>
</table>

Monthly Top 10 Violators

<table>
<thead>
<tr>
<th>Violation Month &amp; Year</th>
<th>License Plate</th>
<th>Total # Issued Tickets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun 2014</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Jun 2014</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Jun 2014</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>
Edmonton Automated Enforcement and Collision Data: January 1, 2010- December 31, 2011

Yellowhead Trail WB RAMP – Victoria Trail NB

<table>
<thead>
<tr>
<th>Year</th>
<th>Right Turn Bay</th>
<th>Total Collision</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>2008</td>
<td>39</td>
<td>42</td>
</tr>
<tr>
<td>2007</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>2006</td>
<td>35</td>
<td>37</td>
</tr>
<tr>
<td>2005</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>2004</td>
<td>20</td>
<td>21</td>
</tr>
</tbody>
</table>
The project cost: $437,240
The collision reduction resulted in an annual cost saving of $887,685
Data, Information, and Knowledge Silos

- 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

Modified from the original picture published in http://blogs.sun.com/bblfish/entry/business_model_for_open_distributed
Traffic Safety Problem
or
Data Problem?
Traffic Data Coordination Committee (TDCC)

Policy direction, strategic and tactical needs

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

Recommended Integrated System and Five-Year Plan

Program oversight

University of Alberta
Data Analysis and Business Intelligence – Traffic Data Integration

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

Transportation Operations

Spatial Business Intelligence Framework
- Road conditions
- Roadway maintenance

Environment Canada
- Weather conditions
- Demographic statistics

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

Edmonton Police Service
- Accidents/incidents

Transit
- Bus Stops & routes
- Passenger counts

Transit Safety & Security

2011 WINNER of IBM SMARTER CITY, one of 24 cities worldwide

Initial Release

NATMEC: Improving Traffic Data Collection, Analysis, and Use
Spatial Business Intelligence (SBI) supports traditional and spatial data through merging Geographic Information Systems (GIS) and Business Intelligence (BI) technologies.
Use BI Launchpad in BusinessObjects 4.0 as an Enterprise Report Portal for sharing business intelligence reports.
Business Intelligence of Traffic Data Integration

The last traffic survey: 2011

Traffic Safety Problem or Data Problem?
Benefits of Business Intelligence

(Eckerson, The Data Warehousing Institute, 2003)
Empirical Bayes analysis led us to identify 170 St - North of 95 Ave as the worst section for traffic collisions.

From 2009 to 2011 there were:
- 55% more collisions than other similar mid-block locations
- 23 more collisions than expected

*Brandt Denham, City of Edmonton Office of Traffic Safety, 2013
### Collisions by Driving Lane (2012)

- 2nd from Curb: 50%
- 3rd from Curb: 8%
- Right Curb: 25%
- Unknown: 17%

- Peak collision periods:
  - Nov-Dec Christmas shopping
  - Fri-Sat weekend shopping
  - Mid afternoon shopping

- 2012 data has less unknown traffic lanes so it may be a more accurate breakdown of the collisions by lane.

- The 2nd from curb lane is lane #3 (The right curb lane is not a through lane)

### Collisions by Cause (09-11)

- Struck Parked Veh: 2%
- Run Off Road: 2%
- Fld. Yield R.O.W.: 6%
- Chng. Lanes: 18%
- Fld. Yield: 72%

### Collisions by Day of Week (09-11)

<table>
<thead>
<tr>
<th>Day</th>
<th>Tickets Issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mon</td>
<td>20%</td>
</tr>
<tr>
<td>Tue</td>
<td>23%</td>
</tr>
<tr>
<td>Wed</td>
<td>57%</td>
</tr>
<tr>
<td>Thur</td>
<td>20%</td>
</tr>
<tr>
<td>Fri</td>
<td>24%</td>
</tr>
<tr>
<td>Sat</td>
<td>36%</td>
</tr>
<tr>
<td>Sun</td>
<td>40%</td>
</tr>
</tbody>
</table>

### Average Monthly Speed Tickets Issued

- Lane 3 (67): 20%
- Lane 1 (77): 23%
- Lane 2 (195): 57%

### Average Monthly Red Light Tickets Issued

- Lane 3 (10): 36%
- Lane 1 (6): 24%
- Lane 2 (11): 40%

### Study area

- The top 5 violators are all rental and cab companies.

### Implementation

- Overhead lane-use Sign Countermeasure
  - 2006: 3
  - 2007: 2
  - 2008: 3
  - 2009: 2
  - 2010: 4
  - 2011: 1
  - 2012: 5
  - 2013: 9
  - 2014 YTD: 0
### Serious (Major) Injuries

<table>
<thead>
<tr>
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<th>2010 (Jan - Dec)</th>
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</tr>
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<tbody>
<tr>
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<td>476</td>
<td>451</td>
<td>426</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td># Serious (Major) Injuries Actual</td>
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<td>445</td>
<td>517</td>
<td>437</td>
<td>137</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th># Serious (Major) Injuries</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 Monthly Cumulative Target</td>
<td>29</td>
<td>55</td>
<td>86</td>
<td>111</td>
<td>145</td>
<td>184</td>
</tr>
<tr>
<td>2014 Monthly Cumulative Actual</td>
<td>24</td>
<td>49</td>
<td>75</td>
<td>98</td>
<td>137</td>
<td>157</td>
</tr>
</tbody>
</table>

**Facts/Data:** Major Injuries did not meet the target in the last two years.

**Questions:**
- What happened in 2012 and 2013 so that we did not meet the target? (Descriptive & Inferential analysis)
- What is the chance of not meeting the target again in 2014? (Inferential – Predictive analysis)
- What is the best course of action to make the major injuries in 2014 lower than the target (Strategic, Tactical and Operational)? (Prescriptive analysis)
Predictive Analytics
Short-Term Weather and Collision Prediction

7-Day Weather Prediction
Source: University of Alberta, Department of Earth and Atmospheric Sciences

7-Day Collision Prediction
Source: City of Edmonton Office of Traffic Safety

City of Edmonton Weather, Collision and Traffic Flow Prediction

Weather Data
Set-up for Edmonton

Calendar Data
Month, Day of Week, Holiday

Traffic Flow Data
VDS Sites: Speed, Volume

Volume & Speed Prediction

Collision Prediction

Future Work

Snow Fall Amount (cm)
1-day-earlier Forecast Snow (cm)
Actual Amount Snow (cm)
7-day-earlier Forecast Snow (cm)
Past Future

Traffic Speed (km/h, Location: SW VDS Site - WMD & 156 St)
High Speed Alert Warranted

Volume & Speed Prediction

Collision Prediction
The Growing Challenge

Collisions in Edmonton 1997-2013

- Total Collisions: Decrease 14,451 injury & fatal collisions (20,795 injuries and fatalities)
- Save $999.8 M

- Population: 17,648 to 29,106
- # Private Passenger Vehicles: 1997 to 3,389

- Total Collisions: 19,128 to 24,803
- Injury and Fatal Collisions: 20,972 to 23,442
- Collisions per 1,000 Population: 29.7 to 30.1
Our Vision:
Zero Fatal and Injury Collisions
Thank You

Contact: Stevanus.Tjandra@edmonton.ca