SUSTAINABLE ROAD SAFETY: A NEW NEIGHBOURHOOD ROAD PATTERN

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Outline

• Motivation
• Methodology
• Results
• Conclusions
• Questions?
Each year more than 1.2 million people die worldwide. (WHO, 2009)

Motivation

One of the top ten leading causes of death. 9th in 2004 (WHO, 2004) 4th in 2020 (Gasper, 2004)
Road Safety Burden

- Economic cost of road injuries varies from 1% to 2% of Gross National Product (GNP).


- The economic cost to Canadians is estimated to exceed $25 billion annually. (Transport Canada 2004)

- Traffic collisions account for around 50% of all accidental deaths. (Transport Canada, 2004)
Canadian Road Safety

3.000
3.500
Observed collisions

Annual traffic fatalities

Year


1.500
2.000
2.500
3.000
3.500

Observed collisions
Fatalities trendline
Vision:2010

www.irf2010.com
• Transportation engineering programs focus on road environment factors.
Road Safety Improvement Programs (RSIPs)

• Traditional RSIP approach:
  o Reactive
  o But.... (disadvantages)

• Proactive road safety
  o Focuses on predicting and improving the safety of planned facilities
  o Collision Prediction Models
Methodology

- Relate Road collisions to land use/road patterns
- Traditional neighbourhood road patterns:
  - Grid pattern
  - Loops and Culs-de-sac
- Emerging patterns:
  - Sustainable Road Safety (Dutch researchers)
  - 3-way Offset (UBC researchers)
  - Fused grid (CMHC researchers)
a. Grid Network (Neo-Traditional)

b. Conventional Network (Cul-de-Sac)

c. Limited Access (Dutch SRS)

d. Offset Network (3-way)

e. Fused Grid

Local Road
Collector
Signal
Data

- Sources:
  - Vancouver, Victoria, Ottawa, Census
  - Auto insurance claims, police records

- Types:
  - Collisions (severe, total), GIS, demographics, traffic volumes, mode splits, road network, signals
• **Stratification**
  4 main themes related to neighbourhood traits
  • **Exposure:** VKT, TLKM, VC
  • **Socio-Demographic:** POPD, WKGD, FS, etc.
  • **TDM:** TCM, DRIVE, SCC, etc.
  • **Network:** INTD, SIGD, I3WP, etc.

VKT = Vehicle Km Travelled
VC = average congestion level
TLKM = Total Lane Km
POPD = Population Density = population/ha
SCC = ShortCut Capacity
INTD = INTersection Density = Intersections/ha
I3WP = 3-way Intersection Percentage = I3W / INT
# Models

<table>
<thead>
<tr>
<th>Themes</th>
<th>Land Use</th>
<th>Derivation</th>
<th>Group #</th>
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<tbody>
<tr>
<td><strong>Exposure</strong></td>
<td>Urban</td>
<td>Modeled</td>
<td>1</td>
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<td>Measured</td>
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<td>Modeled</td>
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<td><strong>Socio-Demographic (SD)</strong></td>
<td>Urban</td>
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<td><strong>Network</strong></td>
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<tr>
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<td>Measured</td>
<td>16</td>
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</tbody>
</table>
• Regression Technique
  
  o Generalized Linear Modelling (GLM) regression method
  o Assumes a Negative Binomial error structure

• Model Form

\[ E(\Lambda) = a_0 Z^{a_1} e^{\sum b_i X_i} \]

  o \( E(\Lambda) \) = predicted collision frequency
  o \( a_0, a_1, b_j \) = model parameters
  o \( Z \) = leading exposure variables (e.g. VKT, TLKM)
  o \( X_j \) = explanatory variables (e.g. VC, POPD, INTD)
Results

- 32 models to analyze Victoria neighborhoods
- 32 models to analyze Ottawa
- 32 models to analyze Vancouver
- In each case, 16 Urban & 16 Rural models, at least one in each model group
Models

• Exposure:

\[ \text{Total Collisions} / 3 \text{ yrs} = 0.3355 \text{VKT}^{0.5685} e^{2.3364 \text{vc}} \]

• Socio-Demographic:

\[ \text{Total Collisions} / 3 \text{ yrs} = 0.2021 \text{VKT}^{0.742} e^{(1.2967 \text{vc} + 0.002621 \text{wkgad} + 0.005645 \text{popd} - 0.254f)} \]

• TDM:

\[ \text{Total Collisions} / 3 \text{ yrs} = 0.1028 \text{VKT}^{0.915} e^{(0.0134 \text{scvc} - 0.0106 \text{core})} \]

• Network:

\[ \text{Total Collisions} / 3 \text{ yrs} = 0.1757 \text{VKT}^{0.8509} e^{(0.4246 \text{sigd} + 0.829 \text{intd} - 0.00405 \text{iwp} - 0.0086 \text{llkp})} \]
Results

![Graph showing collision ratio to the fused grid for different areas](image-url)
Results

256 hectare module

<table>
<thead>
<tr>
<th></th>
<th>Grid Network</th>
<th>Cul-de-sac</th>
<th>Dutch SRS</th>
<th>3-way Offset</th>
<th>Fused Grid</th>
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<tr>
<td><strong>t-Statistics</strong></td>
<td>2.57</td>
<td>1.46</td>
<td>2.39</td>
<td>0.88</td>
<td>1.15</td>
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(t_{8, 90\%} = 1.86)
Conclusions

• Land use patterns effects road collisions
  – If we drive, we crash

• In traditional neighbourhoods
  – short-cutting is the dominant cause of road collisions
  – Traffic calming is needed, or, retro-fit with new patterns

• New neighbourhood road patterns safer by 50%:
  – 3-way Offset: Accessibility, mobility, & safety
  – Fused Grid: Accessibility via off-road paths needs
  – 30%-60% fewer road collisions – stay tuned!
Fused Grid
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