Using New Data Sources to Understand Use of the City of Edmonton’s Downtown Bike Grid

Amy M. Kim, Associate Professor
Laura Cabral, MSc Candidate
Department of Civil & Environmental Engineering, University of Alberta

July 10, 2018
2018 International Conference on Urban Traffic Safety
The Edmonton Downtown Bike Network

- First sections opened in June 2017
- > 7.8 km of protected bicycle lanes
  - Bright green paint
  - Dedicated cyclist signals
  - Advanced stop boxes (bike boxes) at intersections
  - Raised curbs and flexible bollards
  - Aimed for all ages and abilities
Infrastructure costs $$

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Vancouver
Vancouver
Edmonton
Edmonton
Calgary
Montreal
Toronto
Presentation Outline

• Introduction & background
• Edmonton downtown bike network analysis project
  • Connectivity
  • Volumes
• Ongoing work
Infrastructure costs $$
Sharrows
Dedicated but not barrier-separated lane
Principles

- No loss of life is acceptable
- Traffic fatalities and serious injuries are preventable
- We all make mistakes
- We are physically vulnerable when involved in motor vehicle collisions
- Eliminating fatalities and serious injuries is a shared responsibility

**Safe System approach**

1. Engineering  **Supply**
2. Education
3. Enforcement  **Demand**
4. Engagement
5. Evaluation  **Monitoring**
seven goals that reflect The Way Ahead, the City’s 10-year strategic plan.

**Transportation and Land Use Integration**

- The transportation system and land use / urban design complement and support each other so that the use of transit and transportation infrastructure, including the use of transit, is optimized and supports best practices for land use.

**Access and Mobility**

- The transportation system is interconnected and integrated to allow people and goods to move efficiently throughout the city and to provide reasonable access with a variety of modes for people across demographic, geographic, socio-economic, and mobility spectrums.

**Transportation Mode Shift**

- Public transportation and active transportation are the preferred choice for more people making it possible for the transportation system to move more people more efficiently in fewer vehicles.

**Sustainability**

- Transportation decisions reflect an integrated approach to environmental, financial, and social impacts thereby creating sustainable, livable communities that minimize the need for new infrastructure and increase quality of life.

**Health and Safety**

- The transportation system supports healthy, active lifestyles, and addresses user safety and security including access for emergency services, contributing to Edmonton’s livability.
I used to bike like...  

...now I sometimes bike like...  

... but most cyclists we see bike like this.

Strong and Fearless  

Interested but Concerned  

Enthused and Confident
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Infrastructure costs $$
As with any public infrastructure, we want to know if expenditures are justified.

- Is it safe to use?
- How well does it serve popular destinations?
- Will people use the infrastructure?
- Will it integrate well into the existing infrastructure?
- How do people feel about it?

Cycling infrastructure has been more controversial than other transportation infrastructures in Edmonton.
Evaluation is key...
HOW?
Seattle

- Adopted Vision Zero Plan in 2015, with Safe Systems approach (5 E’s)
- Implemented Bicycle Master Plan
- Performance measure: track deaths and serious injuries

**2015 action plan**
- 7 miles of protected bike lanes
- 12 miles of neighborhood greenways

**2017 progress report**
- 3.5 miles of protected bike lanes
- 6.5 miles of neighborhood greenways
Portland

  - Zero deaths and serious injuries by 2025
  - Includes Street Design actions, Impairment actions, Speed actions and Dangerous Behaviors actions

Guidelines for installation of protected bike lanes based on vehicle speeds, volumes, etc.

Guidelines for installation criteria for marked pedestrian and bicycle crossings

Annual capital safety improvements on 2 segments & 5 intersections within High Crash Network

Number of protected bike lane miles installed using guidelines

% of pedestrian and bicycle crossings that meet guidelines

Number of segments with improvements; annual average number of deadly and serious crashes on improved segments

"Ok #Portland when are we getting private #bike lanes? #SLC" by Andrew Fresh is licensed under CC BY 2.0
Toronto

• Vision Zero plan (2017-2021) includes
  • Construction of more cycle tracks and bike lanes
  • Advance green for cyclists, signalized crossings, and automated detection

• Example: Bloor Street West Pilot Project (installed Aug 2016)
  • 2.5 km of one-way cycle tracks on both sides of Bloor Street
  • High-use corridor: 24,000 vehicles and 3,300 cyclists per day
  • Vehicle travel lanes reduced from 2 per direction to 1 per direction
Bloor Street West Bike Lane Pilot Monitoring

**Cycling environment**
- Volume and mode share with 3 weekdays of video counts (4 locations)
- Collision monitoring (1 year)
- Analysis of conflict (near-misses) by U of T

**Motoring environment**
- Volume and mode share with 3 weekdays of video counts (4 locations)
- Travel time runs with GPS tracker (AM, mid-day, PM peaks)

**Curbside demands and parking**
- Number of spaces, Level of service, Revenue

**Local businesses**
- Door-to-door merchant survey
- Pedestrian intercept survey
- Moneris data analysis of transactions

**Public perception**
- Post-installation opinion survey

All data collected before implementation (June 2016) and twice after implementation (October 2016, June 2017) on Bloor Street and two control corridors (Dupont Street – no bike lane, Harbord Street – with bike lane)
Edmonton bike grid monitoring and analysis

1. Is it safe to use?
2. How well does it serve popular destinations?
3. Will people use it?
4. How well does it integrate with the existing infrastructure?
5. How do people feel about it?

Vision Zero team
- Road safety audit before grid construction
- In-service road safety review

University of Alberta
- Network connectivity
- Cycling network usage

Software tools: GIS (ArcMap), R
Data: 3 types of passive sources, survey
Edmonton bike grid monitoring and analysis

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- Cycling network usage
Network connectivity evaluation

Low-stress connectivity framework
(Mekuria et. al)

- **LTS1**
  Suitable for safety-aware children
  *Trails, shared-use paths, low-traffic and low speed limit residential streets*

- **LTS2**
  Suitable for most of the adult population
  *Lower traffic streets and moderate traffic streets with bicycle lanes, lower speed limits*

- **LTS3**
  Suitable for reasonably confident cyclists
  *Streets with moderate traffic and higher traffic streets with bicycle lanes*

- **LTS4**
  Suitable for fearless cyclists
  *Any cycling situation, regardless of traffic volume and speed limit*
Network connectivity evaluation

222 origins within 4 km radius of 3 destinations
Low-stress connectivity 1 (LTS 1): Impact of protected bike lanes

- Reachable area using LTS 1 facilities increased as MacEwan University and Churchill Square are now connected
Low-stress connectivity 2 (LTS 2):
Impact of protected bike lanes

- Reachable area using LTS 2 network increased from 41.7 km² to 62.3 km²
- Number of connected origin-destination pairs increased almost 490% (72 to 423)
Number of origins connected to each destination
(222 OD pairs within 4 km radius)
Before and After Downtown Bikegrid

<table>
<thead>
<tr>
<th>LTS</th>
<th>University of Alberta</th>
<th>MacEwan University</th>
<th>Churchill Square</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
<td>Increase</td>
<td>Before</td>
</tr>
<tr>
<td>LTS1</td>
<td>2</td>
<td>2</td>
<td>0%</td>
<td>0</td>
</tr>
<tr>
<td>LTS2</td>
<td>72</td>
<td>141</td>
<td>96%</td>
<td>0</td>
</tr>
<tr>
<td>LTS3</td>
<td>182</td>
<td>190</td>
<td>4%</td>
<td>182</td>
</tr>
<tr>
<td>LTS4</td>
<td>210</td>
<td>210</td>
<td>0%</td>
<td>210</td>
</tr>
</tbody>
</table>
Edmonton bike grid monitoring and analysis

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- Network connectivity
- Cycling network usage
MioVision counts in the media

Cycling popularity sees drastic rise in year since bike-lane launch – StarMetro Edmonton, June 14, 2018

Use of Edmonton’s bike lanes nearly doubled in first month, numbers show CBC News, Aug 10 2017

Based on the comparison of two 24h counts at 13 locations
Network use evaluation

Are cyclists choosing to use streets with the protected bike lanes over those without?

What types of cyclists are using the bike lanes?

Which routes/streets are most heavily used?

Where are people riding other than bike lanes?

Is there an increase in ridership to/from the downtown core?

From which direction are cyclists entering/exiting downtown?
Three (passive) data sources

- **MioVision**
  - Most expensive
  - Short-term data (limited equipment for several applications) *
  - Spot counts capturing entire population
  - High fidelity

- **ECOCOUNTER**
  - Provides continuous data
  - Fixed locations
  - Spot counts capturing entire population
  - May provide less accuracy compared to manual or MioVision counts

- **STRAVA | METRO**
  - Greatest spatio-temporal coverage
  - Captures small subset of population
  - Younger, more males, experienced cyclists, higher socio-economic status
  - Marketed as “social network for athletes”
Data characteristics

Temporal resolution
- Sample days
- Continuous

Spatial resolution
- Select locations
- Full network (trajectory)

Population capture
- Subset
- All

Miovision
Eco-Counter
Strava
Network use evaluation steps

1. Ensure Eco-Counter counts are reasonably matched to Miovision counts
2. Understand Strava Metro data characteristics (user patterns, routes used, etc.) by comparing to ground counts
3. Establish baseline cycling volumes on the downtown cycling network (Strava)
4. Develop evaluation framework for network performance monitoring
Challenges

Data Coordination
- Different spatio-temporal coverage
- Different delivery formats (data fusion)
- Different delivery schedules
- Multiple partners

Data Quality
- Cross-check data quality (Mio-Vision plus manual counts)
- Calibration issues with automated counters
- Self-selection issue and very small sampling rate (Strava)
1. Compare Strava and Eco-Counter (ranking method)

For each location:
1. Order Strava counts from lowest to highest and assign ranks
2. Order Eco-Counter counts from lowest to highest and assign ranks
3. Compare rankings
Rank difference by day (September 2017) for each location:
Day comparison view
Rank difference by day (September 2017) for each location:
Location comparison view
Rank difference by hour (Sept weekdays, 2017) for each location: Hourly comparison view
Results and limitations of ranking methodology

- Strava ranking affected by high number of zero count periods (despite high level of aggregation used)
- Ranking relationship between Strava & Eco-Counter numbers can vary a lot
- Should be used in conjunction with spatio-temporal autocorrelation techniques → *But we need more locations!*
2. Strava volume comparisons

- Compares the number of Strava users cycling in the downtown core during September weekdays in 2016 and 2017
  - Morning peak (6:30 AM to 9:30 AM)
  - Afternoon peak (3:30 PM to 6:30 PM)
September 2016 vs September 2017

AM peak (weekdays) 6:30 to 9:30
September 2016 vs September 2017

PM peak (weekdays) 15:30 to 18:30
Ongoing work
Ongoing work (1/3)

Expand network connectivity analysis

- Add other central, major destinations (i.e. NAIT, Rogers Place?)
- Use HTS results to weigh connectivity
Ongoing work (2/3)

Continue network use evaluation

1. Ensure Eco-Counter and Miovision counts reasonably match
2. Understand Strava Metro data characteristics by comparing to ground counts
3. Establish baseline cycling volume estimates on downtown network
4. Develop evaluation framework for network performance monitoring
Ongoing work (3/3)

**Bicycle Ridership and Traffic Stress Tolerance Survey**

- Investigate biases of Strava data by collecting users’ characteristics
- Assess stress level presented by protected bike lanes in different environments
- Verify adequacy and relationship between cyclist classification and infrastructure classification

3. Will people use it?

**WHO??**
### Survey: Person vs infrastructure classifications

**Cyclist classification**  
*(Geller; Dill et. al)*

<table>
<thead>
<tr>
<th>Classification</th>
<th>Infrastructure classification</th>
</tr>
</thead>
</table>
| No Way No How             | Suitable for safety-aware children  
  *Trails, shared-use paths, low-traffic and low speed limit residential streets* |
| Interested but Concerned  | Suitable for most of the adult population  
  *Lower traffic streets and moderate traffic streets with bicycle lanes, lower speed limits + LTS1* |
| Enthused and Confident    | Suitable for reasonably confident cyclists  
  *Streets with moderate traffic and higher traffic streets with bicycle lanes + LTS2* |
| Strong and Fearless       | Suitable for fearless cyclists  
  *Any cycling situation, regardless of traffic volume and speed limit + LTS1, LTS2, and LTS3* |
Survey: Stress levels on protected bike lanes

Example video clip

- Will measure environmental variables
  - Vehicular speed
  - Number of travel lanes
  - Land use
  - Parking presence
  - Tree and vegetation presence

How comfortable would you feel cycling at this location?
Edmonton bike grid monitoring and analysis

1. Is it safe to use?
2. How well does it serve popular destinations?
3. Will people use it?
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5. How do people feel about it?

Survey
- User characteristics
- Infrastructure classification by user characteristics (LTS)

Network connectivity
- Accessibility by cyclist categories

(Passive) data
- Quality assessment
- Relationships and complementarity; modelling applications
- Monitoring

Comprehensive analysis of the infrastructure
Lessons for the future
References

Acknowledgments

• Project sponsor: City of Edmonton Office of Traffic Safety
• Special thanks to U of A students Matthew Woo and Robert Xu for their inputs and assistance
Thank you

Amy M. Kim, Ph.D., P.Eng.
amy.kim@ualberta.ca