A DASHBOARD TOOL FOR MAPPING AND EVALUATION OF COMPLETE STREETS IN TORONTO

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MOTIVATION FOR THE COMPLETE STREETS PROJECT

- **Evidence-based** design tools needed to assess **trade-offs** between the many possible uses of roadway space
- Most empirical evidence for street design focuses on automobile and transit throughput
- Design guidelines for complete streets are **rarely based on empirical evidence** of their relationship to behaviour or **user experience**.


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SIDE
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REIMAGINING THE EASTERN WATERFRONT
47


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PEOPLE ARE
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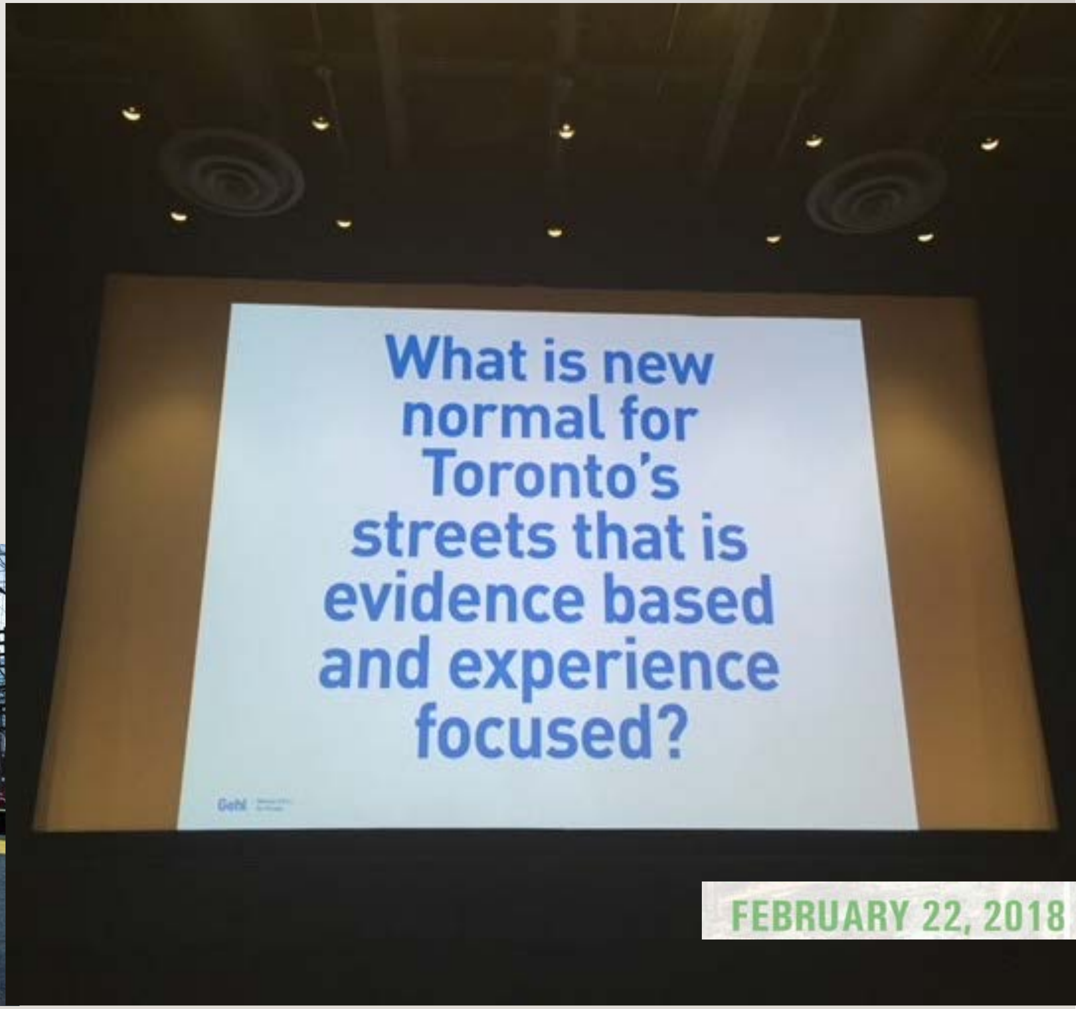
What is new normal for Toronto's streets that is evidence based and experience focused?
Gehl
FEBRUARY 22, 2018

OBJECTIVES OF THE 5-YEAR COMPLETE STREETS PROJECT

1 Review the Complete Streets Literature

2 Build the Evidence-base using 3D Walkability Survey

3 Evidence-Based Design Toolbox

4 Map-based Visualization Dashboard

I REVIEW OF COMPLETE STREETS LITERATURE

Well established empirical methods for assessing traffic and transit level of service

Few methods exist to empirically evaluate walkability and user experience

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Routledge
Taylor & Francis Group

Check for updates

Measuring the completeness of complete streets

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ABSTRACT

A tool for measuring the "completeness" of a complete street has applications in developing policy, prioritising areas for infrastructure investment for a network, and solving the right-of-way allocation problem for individual streets. A literature review was conducted on the state-of-art in the assessment complete street designs. Complete streets assessment requires a context-sensitive approach, thus context-sensitive standards of "completeness" must first be established by combining a street classification system with sets of priorities and target performance levels for the different types of streets. Performance standards should address a street's fulfilment of the movement, environmental, and place functions, and be flexible enough to account for the many ways that these functions of a street can be fulfilled. Most frameworks reviewed are unsuitable for evaluating complete streets because, with few exceptions, they guide street design by specifying the design elements for inclusion on the street. Secondly, the performance of a street can be assessed according to transportation, environmental, and place criteria, and compared to the target performance levels specified by the street's classification. As there are many different impacts to consider on a street, additional work is required to define the priorities and performance objectives for different types of streets.

ARTICLE HISTORY
Received 11 July 2016
Accepted 21 February 2017

KEYWORDS
Complete streets; context-sensitive design; transportation; place; environment

2 BUILD THE EVIDENCE BASE USING WALKABLE STREET 3D SURVEY

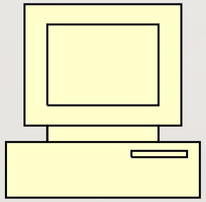
1	30	3	15	4
2	30	1	35	4
3	30	1	20	4
4	20	1	25	4
5	25	5	30	2
6	20	3	35	2
7	20	1	20	4
8	25	3	40	2
9	25	5	25	2
10	20	5	15	2
11	30	5	30	2
12	25	3	40	4

experimental design

online survey respondents

0 0 1 0
0 1 0 0
0 1 0 0
0 0 0 1
1 0 0 0
0 1 0 0
1 0 0 0

data



estimation

$\hat{\beta}$

$se(\hat{\beta})$

results

evidence base

informed planning

complete Streets

Partially adopted from Rose & Bliemer (2009)

WALKABLE STREET 3D SURVEY

- Formal stated preference design on 600 respondents
- Visualized 3D animated environment
- Statistical analysis of using mixed logit model with panel effects

DEMONSTRATION OF THE WALKABLE STREET 3D SURVEY

http://ecce.esri.ca/icitysurvey/

3 EVIDENCE-BASED DESIGN TOOLBOX

- Based on Evidence based from the literature, and survey outcomes
- Initially a spreadsheet model
- User inputs data and then modifies street layout for a single street
  Outputs are scores

INPUTS

Roadway Specifications

	Grass	Sidewalk	Buffer	Striped parking	Bike Lane/ paved shoulder	Buffer/ striped parking	Curbside through lane	Through lane 2	Through lane 3	Median/2-way left turn lane	Through lane 4	Through lane 5	Curbside through lane	Buffer/ striped parking	Bike Lane/ paved shoulder	Striped parking	Buffer	Sidewalk	Grass
Width (m)	3	1.5	2.4	0	1.5	0.2	3.6	0	0	3	0	0	3.6	0.2	1.5	0	2.4	1.5	3
Designed with permeable materials?	TRUE		TRUE							FALSE							TRUE		TRUE

Roadway Information

Is there a raised buffer between sidewalk and other users (e.g. planters, trees)?	FALSE	Is there unstriped parking in the curb lane?	FALSE	Is the median actually a 2-way left turn lane?	TRUE

Note: designed for analysis of symmetrical roadways only. In reality each direction of travel should be analyzed seperately

Miscellaneous Design Parameters

Available width (m)	34
Street Classification	Local Arterial
Pavement condition (1:Worst; 5:Best)	3
Is street in CBD of a city with population > 5M?	TRUE
Are there also exclusive left-turn lanes? (2-way left turn lane does not count)	FALSE
Segment Length (m)	200
Signal Progression Type	Adverse signal progression

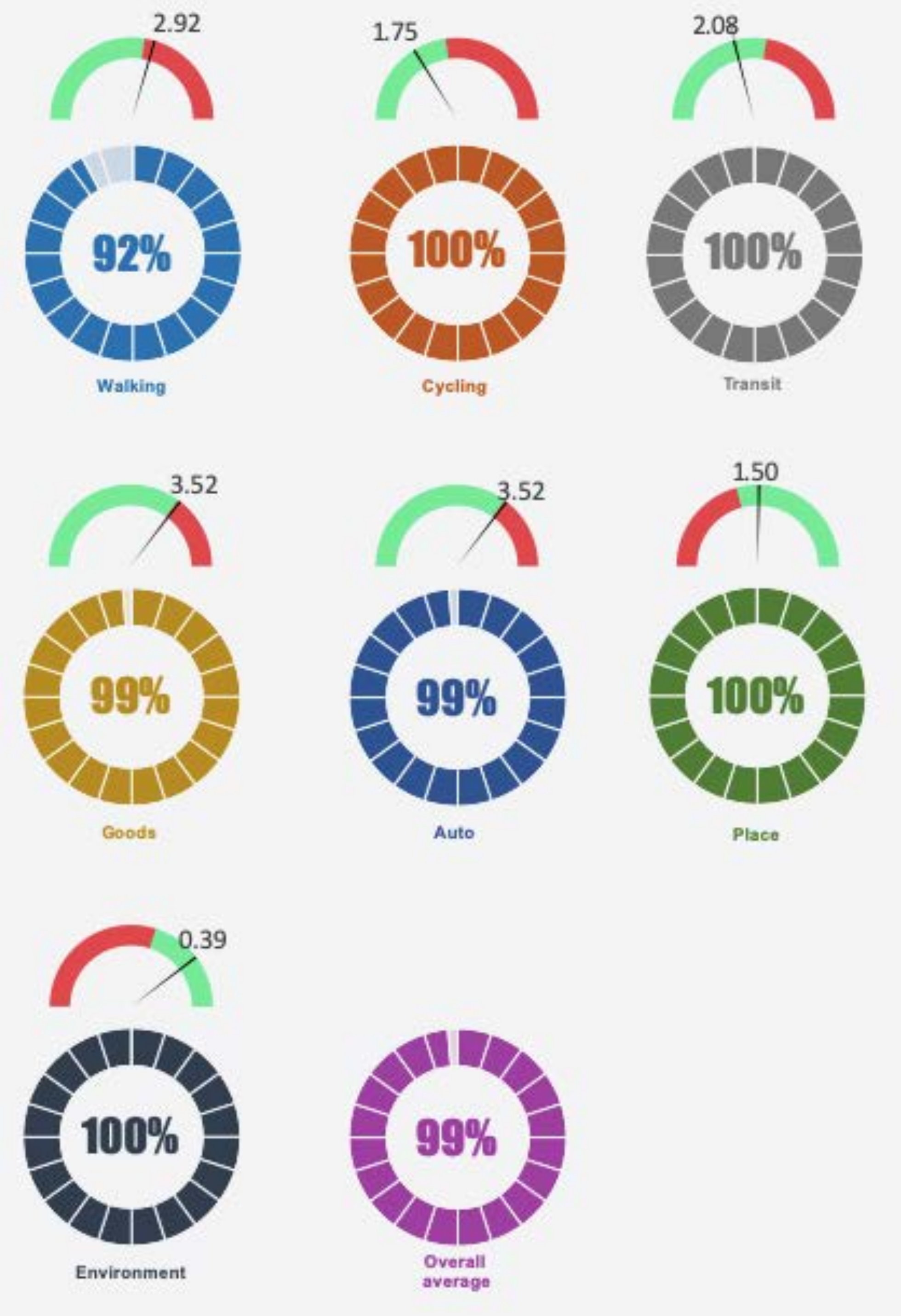
Auto Traffic Flow Parameters

Posted Speed Limit (km/h)	56
Average operating speed (km/h	29.17
Average annual daily traffic volume *	10000
Peak Hour Factor *	0.92
Peak Factor *	0.08
Directional Factor *	0.55
Percentage heavy vehicles	5%
On-street parking occupancy	0%

Transit flow parameters

Has buses?	TRUE
Has streetcar?	FALSE
Average transit operating speed	20
Transit Headway (minutes)	10.82
Average excess wait time per trip *	10.51
% bus stops in study section direction with shelters	100%
% bus stops in study section direction with benches	0%

OUTPUTS


2.92
1.75
2.08
92%
100%
100%
Walking
Cycling
Transit
3.52
3.52
1.50
99%
99%
100%
Goods
Auto
Place
0.39
100%
99%
Environment
Overall average

4 MAP-BASED VISUALIZATION DASHBOARD

4 MAP-BASED VISUALIZATION DASHBOARD

- OCAD University Team:
  - Veda Adnani, Research Assistant
  - Iman Kewalramani, Research Assistant
  - Dr. Greice Mariano
  - Prof. Jeremy Bowes
  - Dr. Sara Diamond
- University of Toronto Team:
  - Bo Wang
  - Prof. Matthew Roorda

DASHBOARD CONTEXT

Source: City of Boulder Colorado

Complete Streets Evaluation Tool

Hi, this spread sheet is a tool for measuring the "completeness" of a complete street. This tool can be utilized to develop policy, prioritize areas for infrastructure investment for a network, and solve the right-of way allocation problem for individual streets.

Simply follow the listed steps to obtain a comprehensive evaluation of a specific street segment:

1
Open the tab named "Input," and provide characteristics of a roadway for evaluation. Note that all input cells are shaded in orange colour and their values can be adjusted by either sliders or drop-down lists.

2
In the "Roadway Specifications" box, set the width of different parts of a symmetric roadway using sliders below each value. Assign the materials types (permeable or impermeable) using drop-down lists.

3
In the "Roadway Information" box, provide more detailed information of the roadway by selecting "True" or "False" from each drop-down list.

4
Three "Parameters" boxes need inputs to collect miscellaneous design, auto and transit flow information. The inputs can be selected using sliders or drop-down lists.

5
Under the "Geometric Constraints Check" table, check that the violations check cells (shaded in darker grey) are all "FALSE."

6
The performance of the given roadway is evaluated, and the results are summarized in two charts located on top of the input boxes:

6a: Bar charts
This bar chart shows and compares the LOS and target scores for each category. An additional bar also indicates the performance in percentage.

6b: Gauges
The LOS scores are shown on gauges. Green/red areas are determined by the target scores, and when a needle falls into the green area it means that LOS score meets the targets. The overall performance (in percentage) is also displayed for each category and the overall rating below each gauge.

Instruction | input | Design | Results | Classifications | bicycle | pedestrian | transit | goods | auto | Env | Place

DASHBOARD CONTEXT

- Create a tool that can act as a bridge between governance and urban design, to allow planners to focus on user needs and optimize their processes.

OBJECTIVE OF THIS STUDY

- Design a dashboard tool that provides a model to test prototypical Complete Streets combinations, and to support urban design and transportation planning decision making.

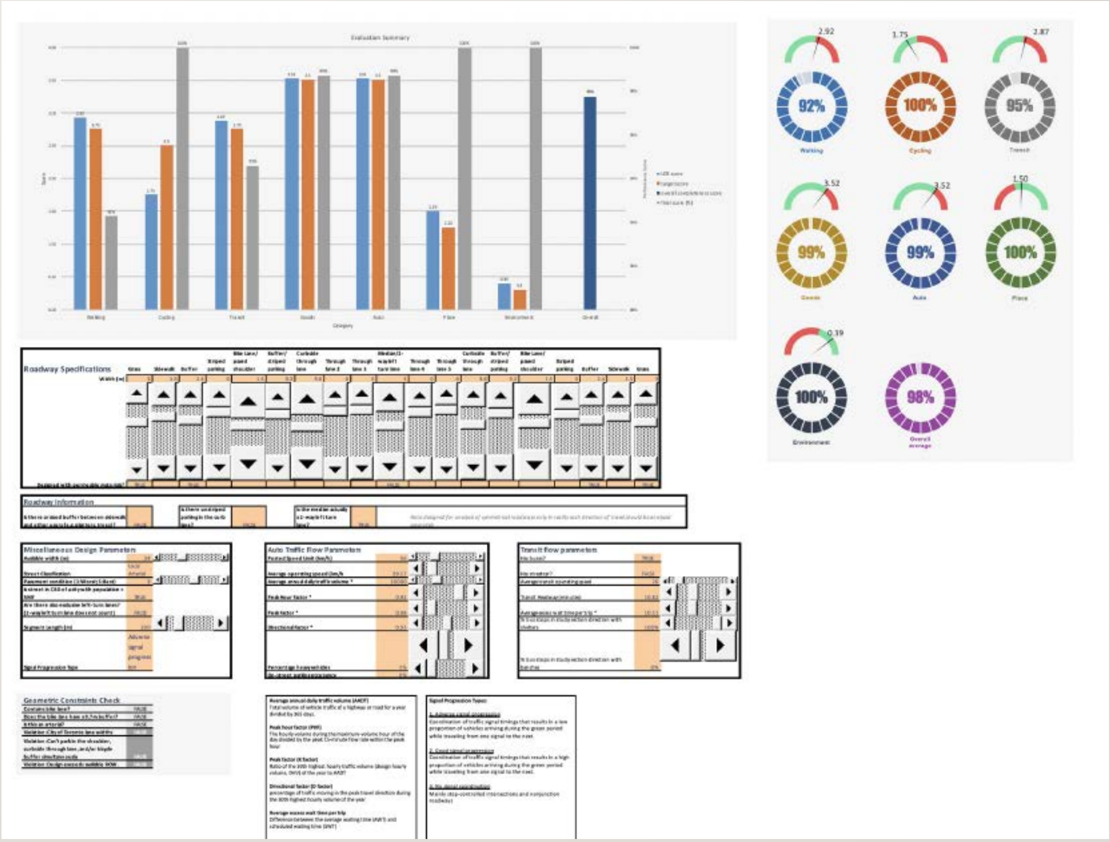
PROCESS OVERVIEW

DASHBOARD DESIGN

DASHBOARD IMPLEMENTATION

DESIGN CONSIDERATIONS:

- Usability
- Scalable
- Universal
- Adaptive

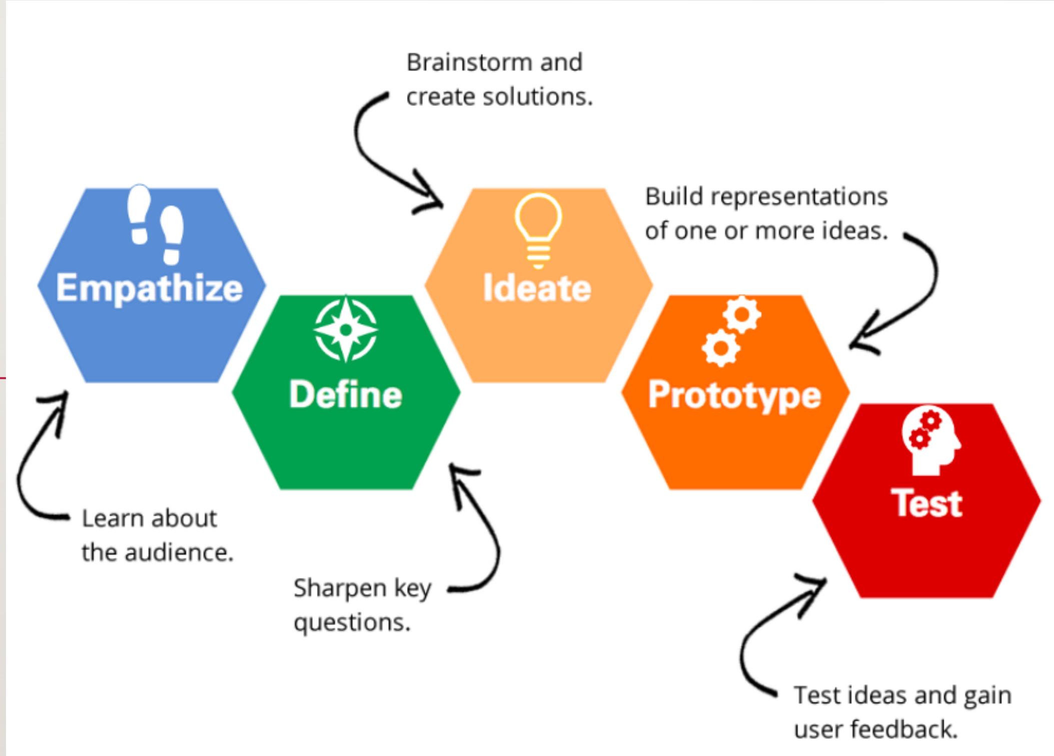


INTERFACE DESIGN APPROACH

- Design Thinking
- Principles of Usability
- User-centered design

INTERFACE DESIGN APPROACH

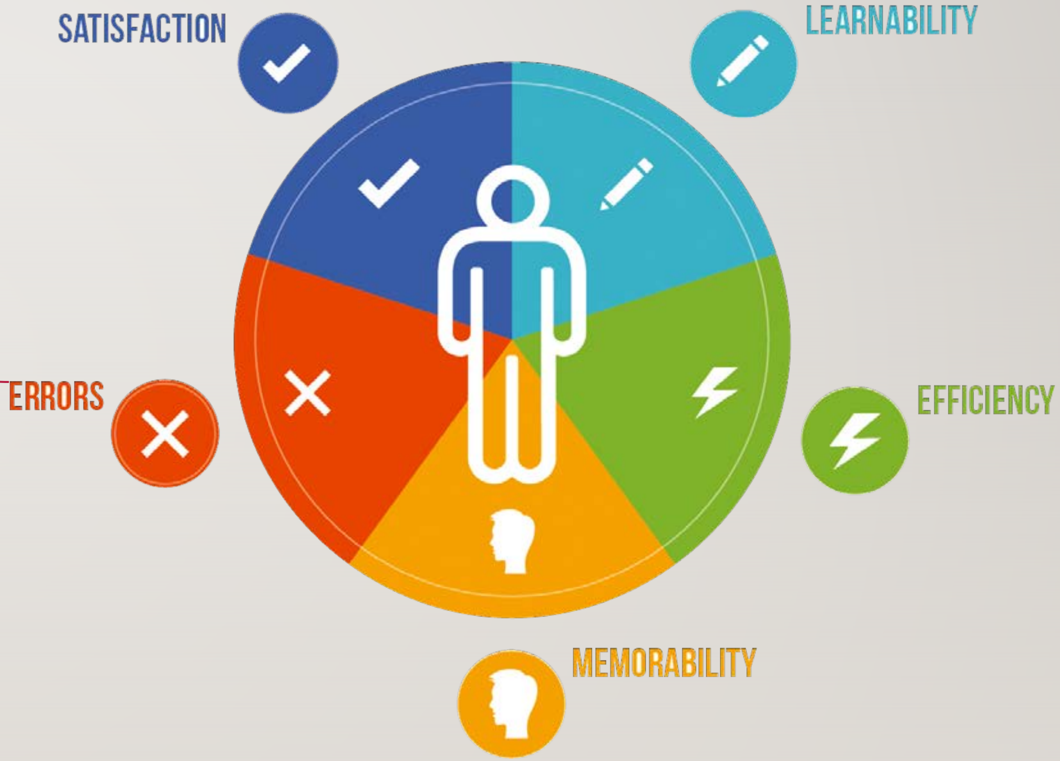
- **Design Thinking**
- Principles of Usability
- User-centered design



Source: MOVINGWORLDS Blog

INTERFACE DESIGN APPROACH

- Design Thinking
- **Principles of Usability**
- User-centered design



Source: CLIPARTMAX

[Nielsen, 2012]

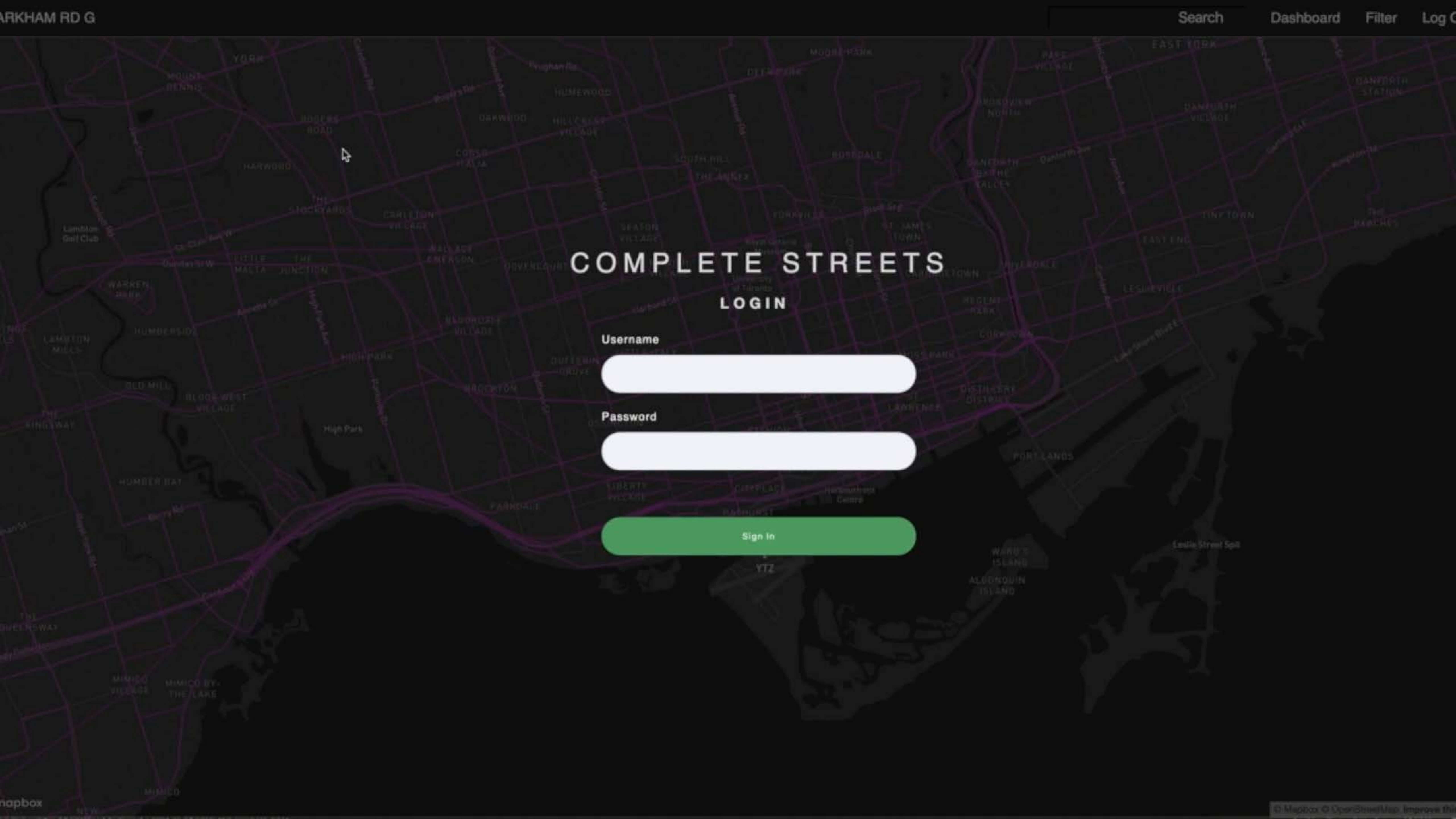
INTERFACE DESIGN APPROACH

- Design Thinking
- Principles of Usability
- **User-centered design**

✓Simple	✓Meaningful
✓Clear	✓Extendable
✓Consistent	✓Collaborative

[Shneiderman, 2016]

DEMONSTRATION:
COMPLETE STREETS DASHBOARD TOOL


ARKHAM RD G
Search
Dashboard
Filter
Log
COMPLETE STREETS
LOGIN
Username
Password
Sign In
apbox

INTERFACE DESIGN OVERVIEW

- **Colour Usage:** The interface has been designed in black to minimize the load on the eyes. Colour use is minimal, function first. Key action colours such as green and red that are easily recognizable have been used to denote positive and negative actions.
- **Typography:** Clean sans-serif fonts have been used to allow the user to focus on the task at hand. They provide visual relief and make it easy to read at all sizes.
- **User Interface Elements:** Typical usability patterns for buttons, sliders, checkboxes and dropdowns have been used so that the user does not have to expend cognitive load on figuring out what the elements can do. These elements can be found on most web and mobile interfaces.

DATA STRUCTURE


```
▼ object {3}
    ▼ mainParam {21}
        Grass : 2
        Sidewalk : 4
        Buffer : 1
        StripedParking : 2
        BikeLane/PavedShoulder : 2
        Buffer/StripedParking : 2
        CurbsideThroughLane : 2
        ThroughLane2 : 2
        ThroughLane3 : 2
        Median/2-wayLeftTurnLane : 2
        ThroughLane4 : 2
        ThroughLane5 : 2
        CurbsideThroughLane2 : 2
        Buffer/StripedParking2 : 2
        BikeLane/PavedShoulder2 : 2
        StripedParking2 : 2
        Buffer2 : 2
        Sidewalk2 : 2
        Grass2 : 2
        ▼ roadwayInfo {3}
            riasedBuffer : false
            UnstripedParking : false
            2-wayLeftTurnLane : true
    ▼ miscellaneousDesignParameters {7}
        availableWidth : 19
        streetClassification : 1
        PavementCondition : 8
        CBD : true
        exclusiveLeft : true
        segmentLength : 200
        signalProgressionType : true
    ▼ autoTrafficFlowParameters {8}
        postedSpeedLimit : 20
        averageOperatingSpeed : 20
        averageAnnualDailyTrafficVolume : 100
        peakHourFactor : 3
        peakFactor : 2
        directionalFactor : 4
        percentageHeavyVehicles : 10
        parkingOccupancy : 67
```

IMPLEMENTATION ASPECTS

Frontend

Backend

PUBLICATION

"Designing a Dashboard Visualization Tool for Urban Planners to Assess the Completeness of Streets", 22th International Conference on Human-Computer Interaction, Copenhagen, Denmark, July, 19-24, 2020. (to be pulished)

G. Mariano, V. Adnani, I. Kewalramani, B. Wang, M. Roorda, J. Bowes, S. Diamond

Designing a Dashboard Visualization Tool for Urban Planners to Assess the Completeness of Streets

Greice C. Mariano[1](✉), Veda Adnani[1], Iman Kewalramani[1], Bo Wang[2], Matthew J. Roorda[2], Jeremy Bowes[1], and Sara Diamond[1]

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Abstract. This paper presents a design study for a novel interactive web-based visualization tool that utilizes a "Complete Streets" model to support urban planners and engineers to design streets in urban areas more effectively. The proposed tool integrates a map and a dashboard view, where streets are analyzed and scored based on their overall completeness through six parameters of service; automobile, public transit, goods vehicles, environment, pedestrians and cyclists. In the map view, planners can assess streets based on their location, type and form and perform comparisons between multiple streets. In the dashboard view, planners can tweak a comprehensive set of instructions within each of the six parameters and view the effects of their changes in real time for both overall completeness and across parameters. Planners can also save versions to revisit and tweak them whenever necessary and may also download their dashboard data in different formats. We proposed that planners will be able to assess the completeness of existing streets in their current state and create multiple street prototypes exploring different scenarios and combinations virtually, instantaneously, minimizing costly pilots and prototypes. Future iterations will also promote collaboration and sharing across dashboards.

Keywords: Dashboard design · Urban systems · Transportation

1 Introduction

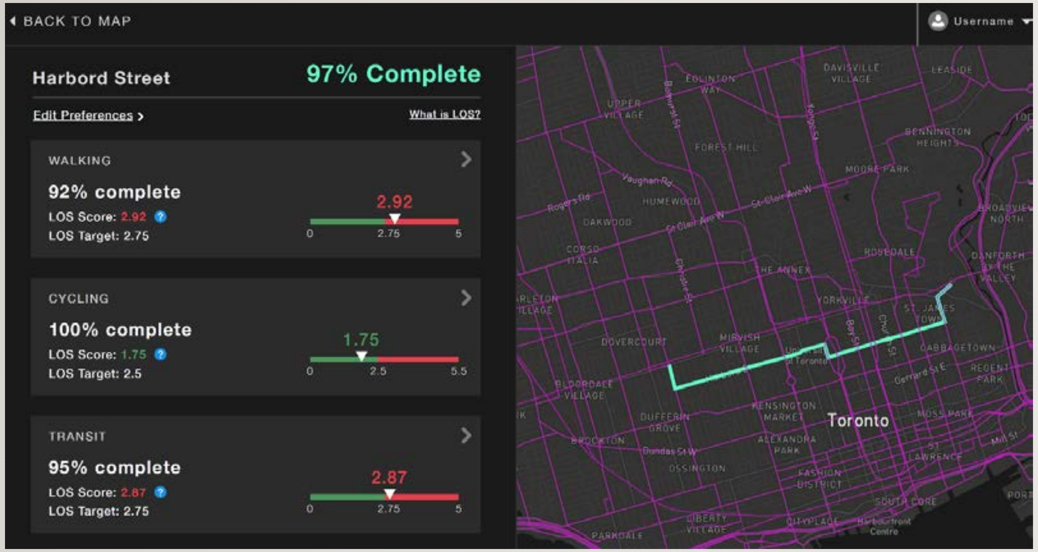
Urban sustainability is one of the most pertinent issues of the twenty-first century, given that more than half of the world's population now lives in cities [12]. Cities are becoming complex systems of systems, with spatial needs in urban areas increasing rapidly, while the available urban area that is available remains unchanged. Automobiles, public transport vehicles, pedestrians and cyclists are all competing within the same amount of space, and it is becoming imperative

S. Yamamoto and H. Mori (Eds.): HCII 2020, LNCS 12184, pp. 1–19, 2020.
https://doi.org/10.1007/978-3-030-50020-7_6

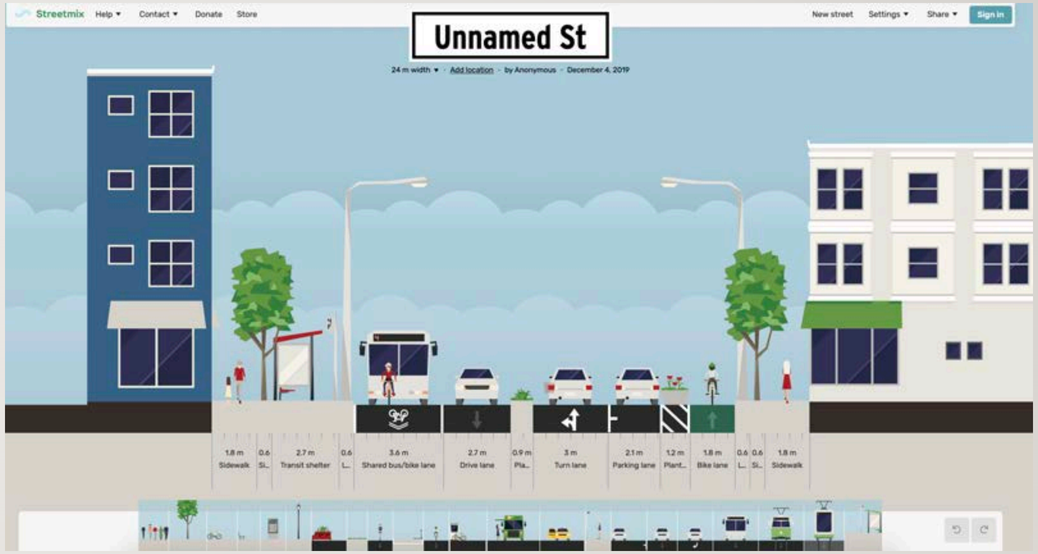
NEXT STEPS

- User Testing
- Further UI development
- Explore Scalability of the tool across different geographies
- Responsiveness

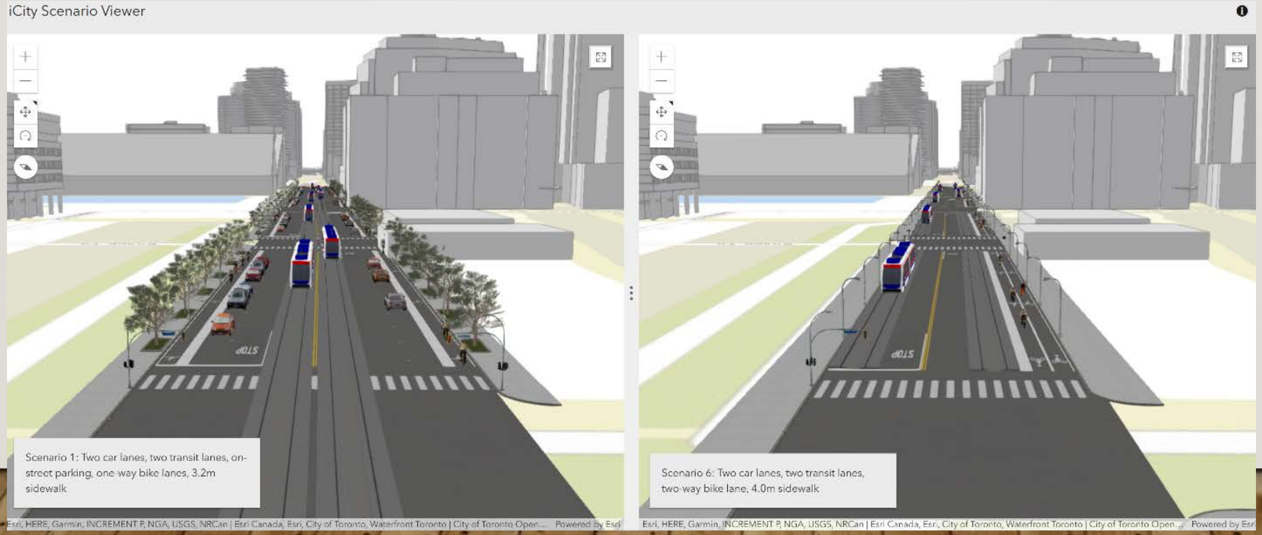
NEXT STEPS – ESRI CANADA



Current Prototype developed by OCAD team



Streetmix 2D cross-sectional complete streets tool



A 3D webscene of complete street options generated in CityEngine.

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- MITACS