

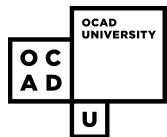
Designing a Dashboard Visualization Tool for Urban Planners to Assess the Completeness of Streets

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iCity-ORF

Urban Informatics for Sustainable Metropolitan Growth

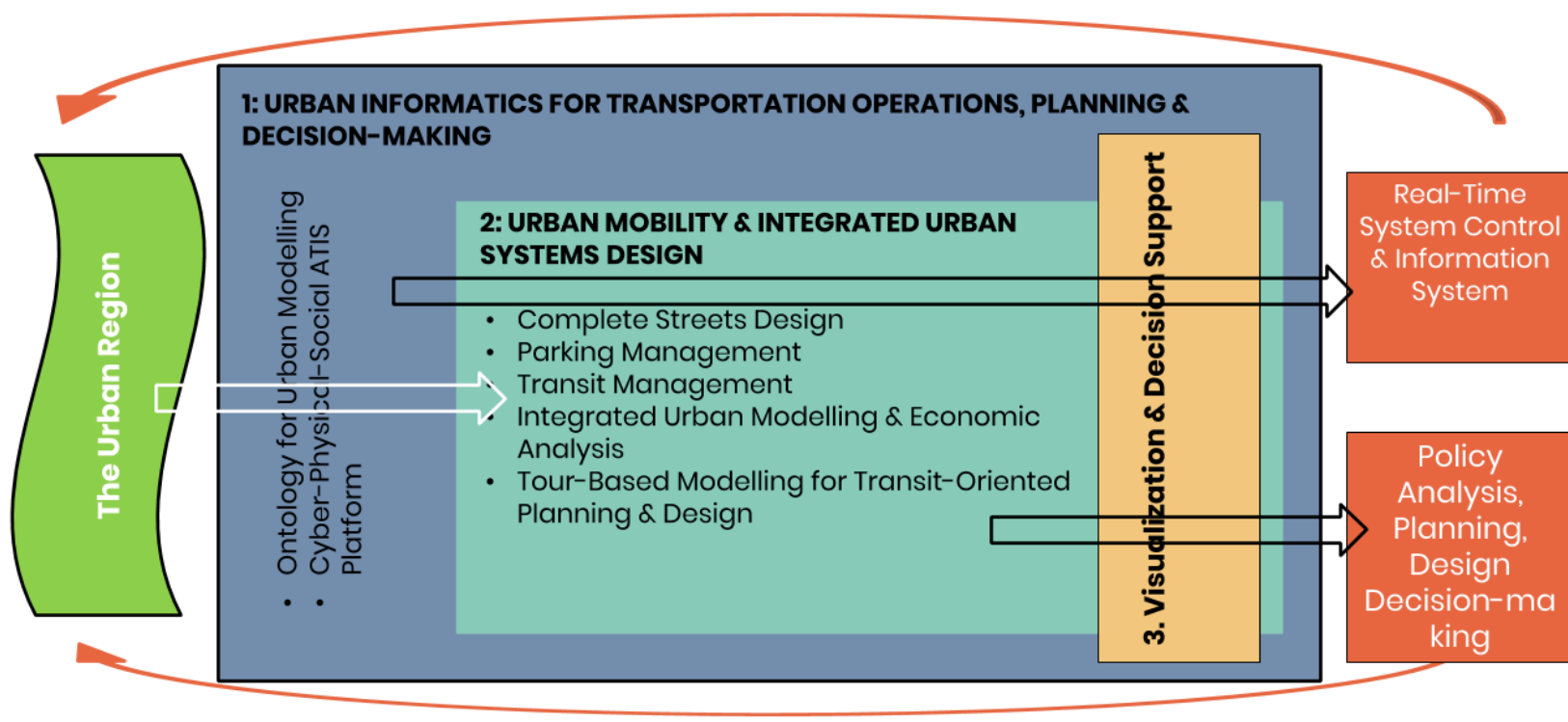


IMAGE: Katsumi, M. & Fox, M. (2020)

Agenda



INTRODUCTION



CONTEXT



DESIGN



DEMO



CONCLUSIONS



NEXT STEPS

Introduction

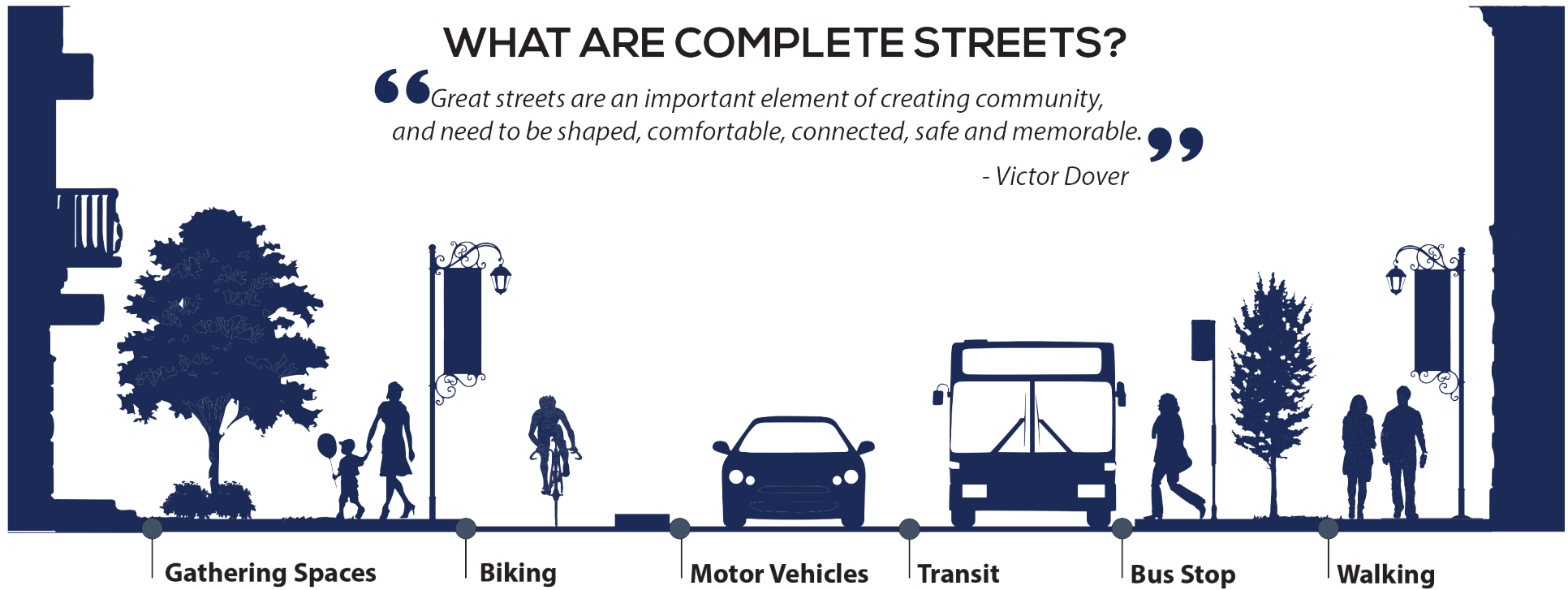
- No Sidewalks
- Too dangerous to cross on foot
- Uninviting for bus riders
- Inaccessible for wheelchair users
- Inadequate



Introduction

WHAT ARE COMPLETE STREETS?

“Great streets are an important element of creating community, and need to be shaped, comfortable, connected, safe and memorable.”
- Victor Dover

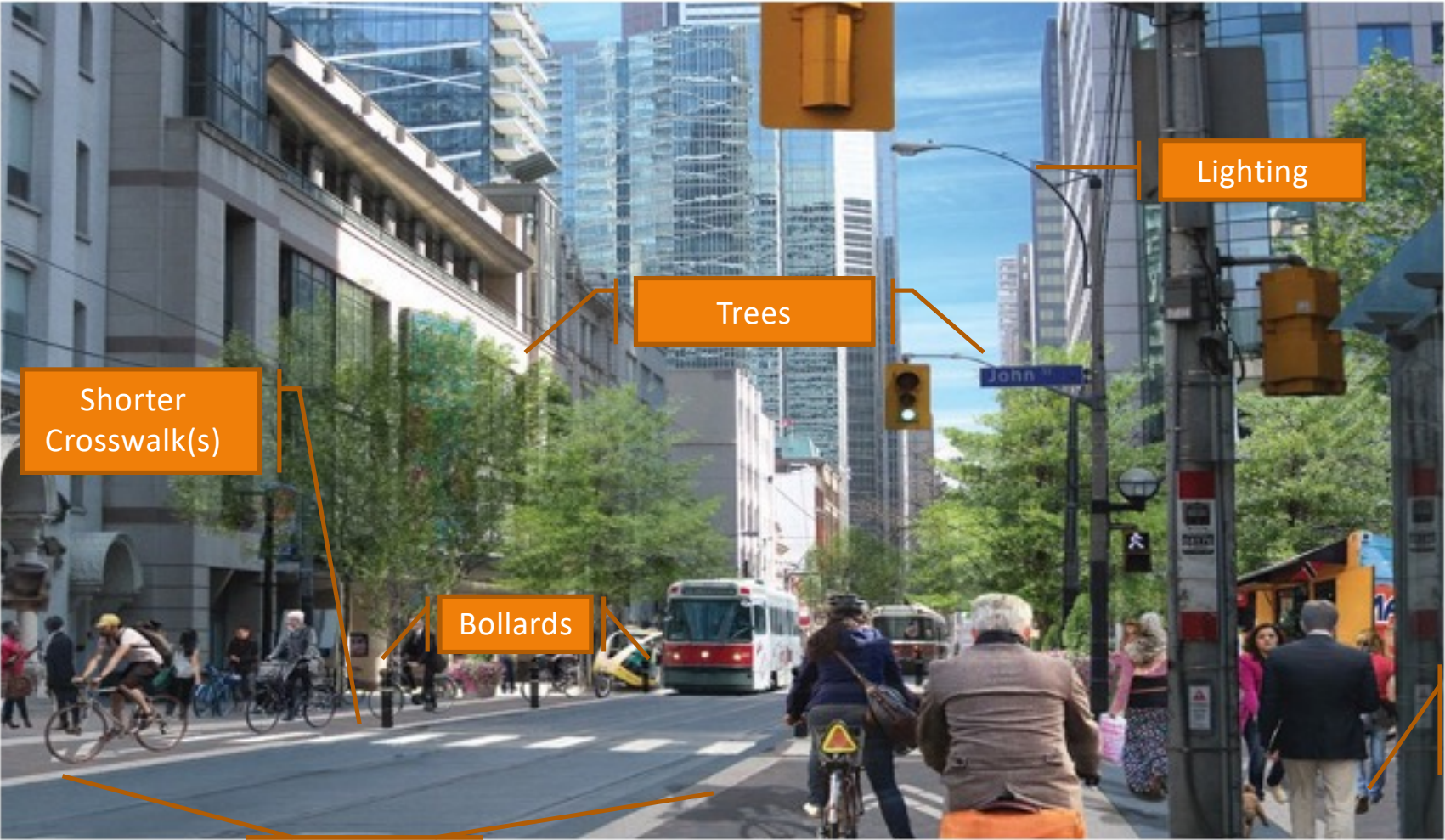


Source: City of Boulder Colorado

Complete Street Elements



Complete Street Elements



Shorter
Crosswalk(s)

Trees

Lighting

Bollards

Bike Lanes

Sidewalk(s) for
Pedestrians

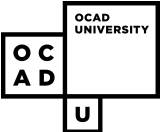


IMAGE: King Street Pilot, Toronto, ON, Canada
Visual Analytics Lab On Street, iCity Team

Complete Streets Examples



A D
U

Completeness Tool

Overview:

- Developed by University of Toronto Team to measure the completeness of Complete Streets according to the concept presented by Hui et al. (2017)

Objective:

- Evaluation of a specific street segment based on Level of Service (LOS) model equations and criteria

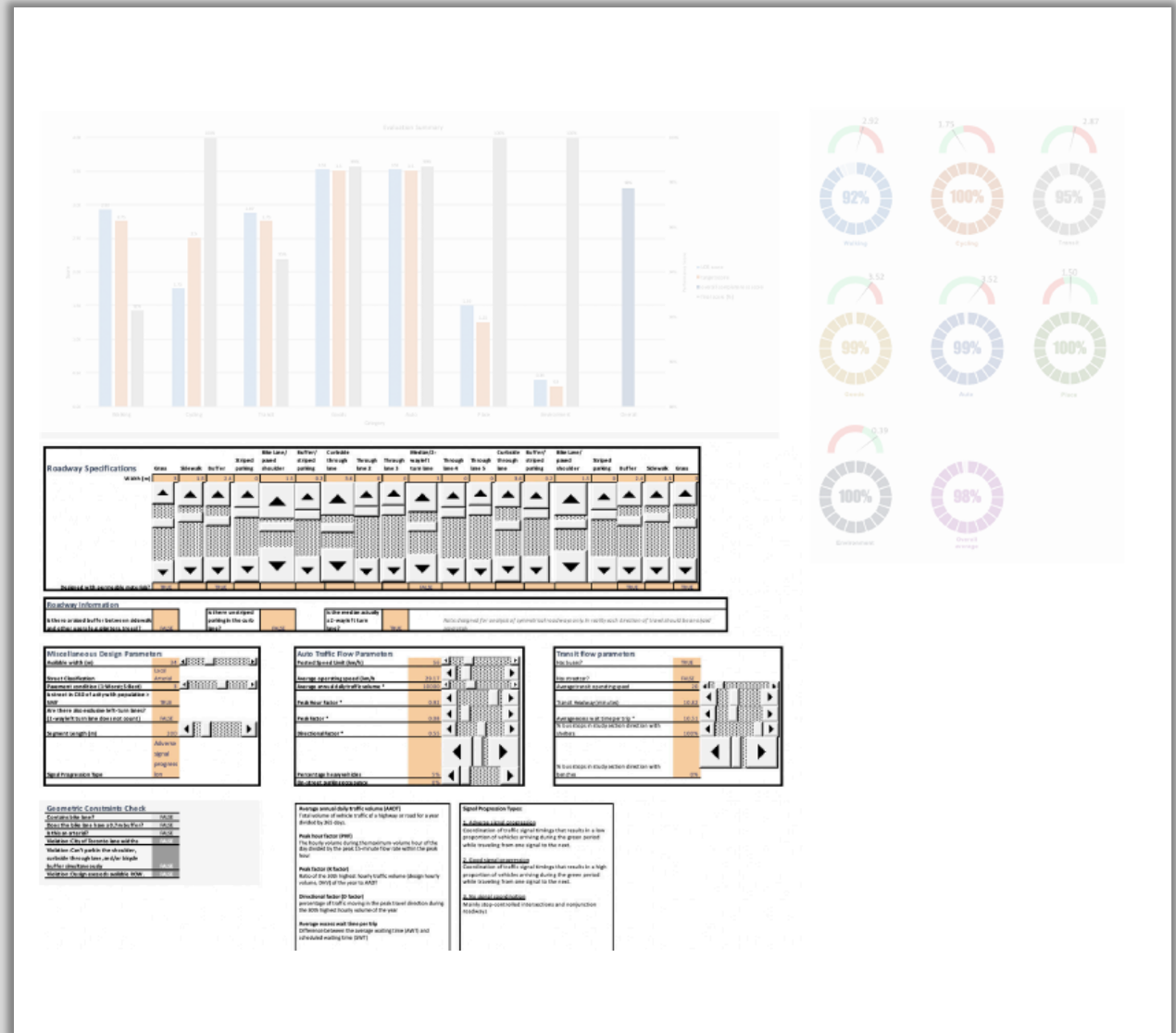
Used for:

- Support the development of policies and guidelines
- Prioritize areas for infrastructure investment for a network
- Solve the right-of-way allocation problem for individual streets

Completeness Tool

INPUTS (Parameters):

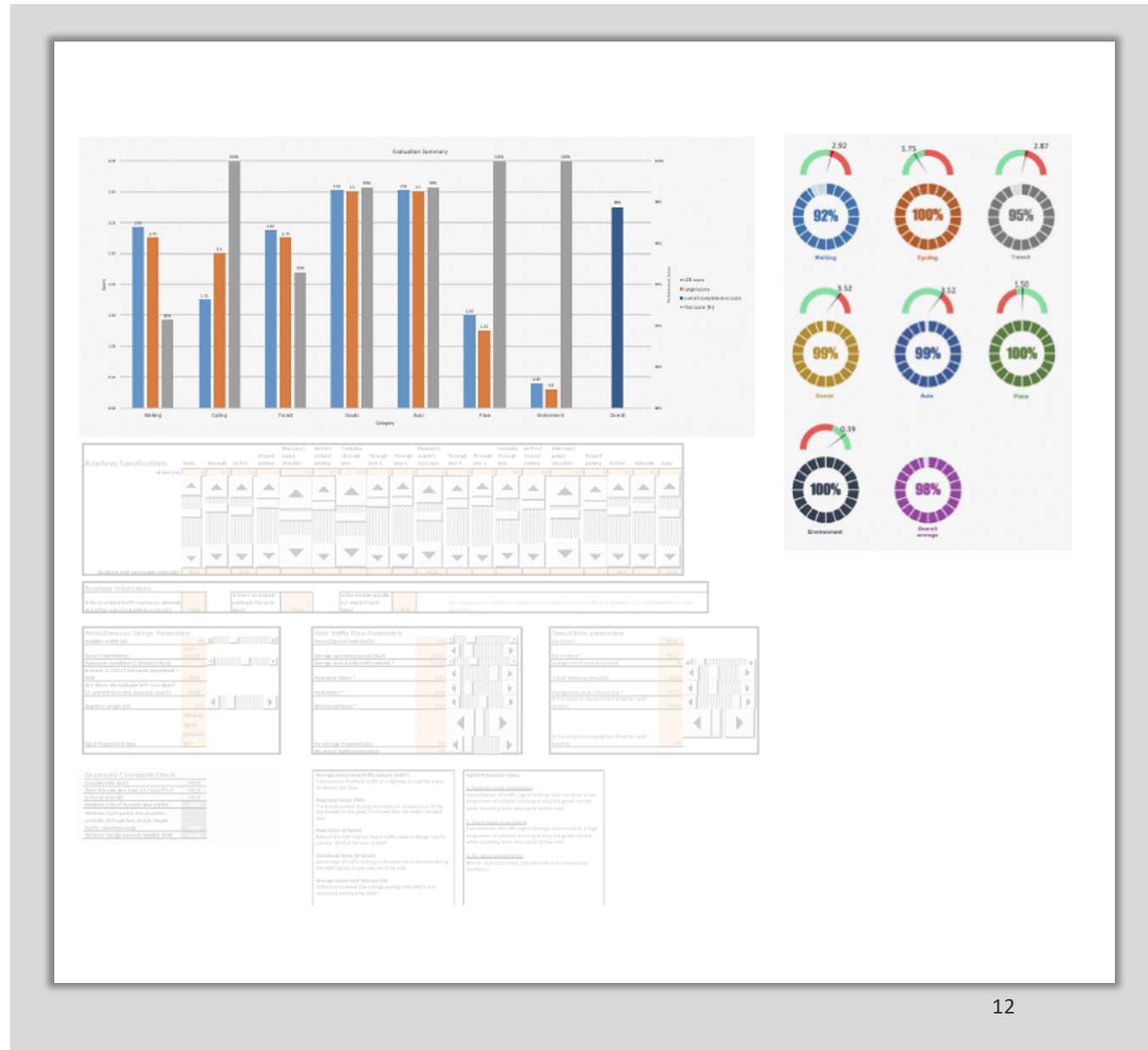
- Roadway Specifications:
 - Example: width of sidewalk, width of bike lane
- Design:
 - Example: type of street, if there is bike lane
- Traffic and Transit Flow:
 - Example: if has buses, streetcars, average operation speed (Km/h)



Completeness Tool

OUTPUTS (Charts):

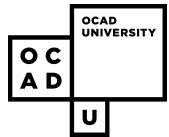
- Bars
 - Shows and compares the LOS and target scores for each category
 - Has an extra bar for overall performance
- Gauge
 - Green and Red areas are defined by the target scores
 - If the computed scores falls into the green area it means that LOS score meets the target.



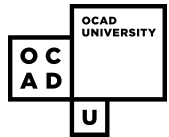
Design Considerations

Challenges posed with the use of spreadsheet format:

- Usability
- Interoperability
- Scalability
- Visualization



Complete Streets Dashboard Design



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**.

Design Thinking

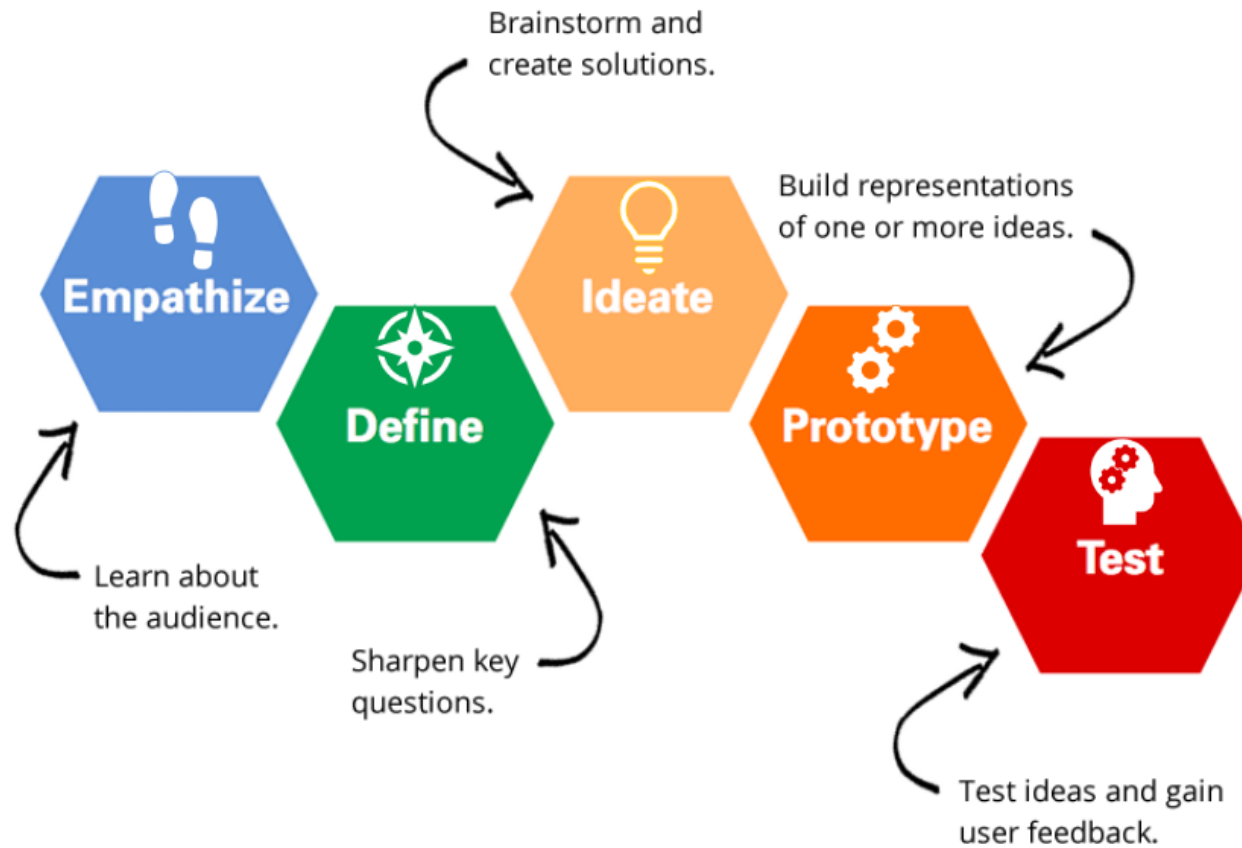
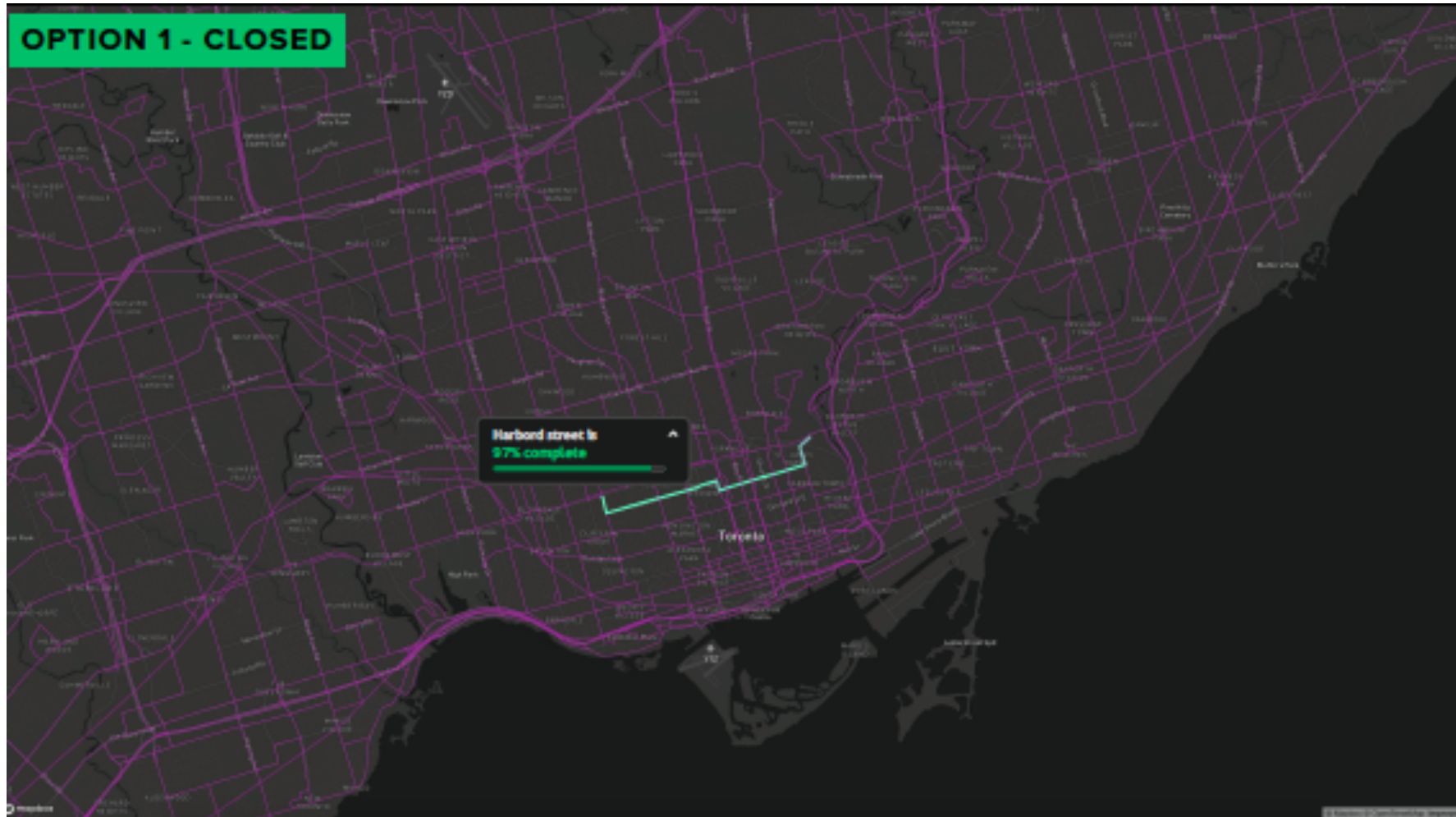


IMAGE: MOVINGWORLDS Blog

[Brown, 2009; IDEO, 2020]

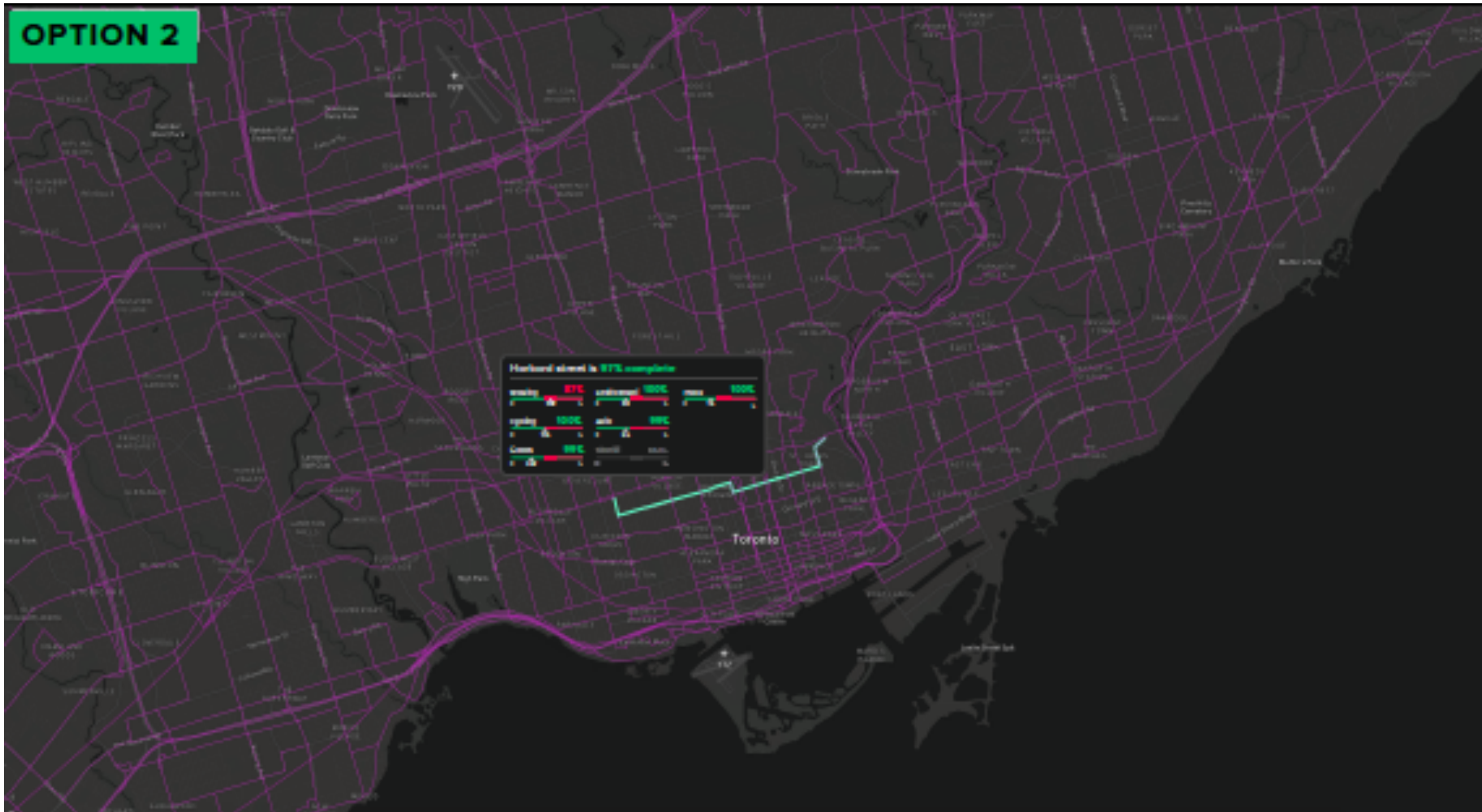
Low Fidelity Prototype



Low Fidelity Prototype



Low Fidelity Prototype



Principles of Usability

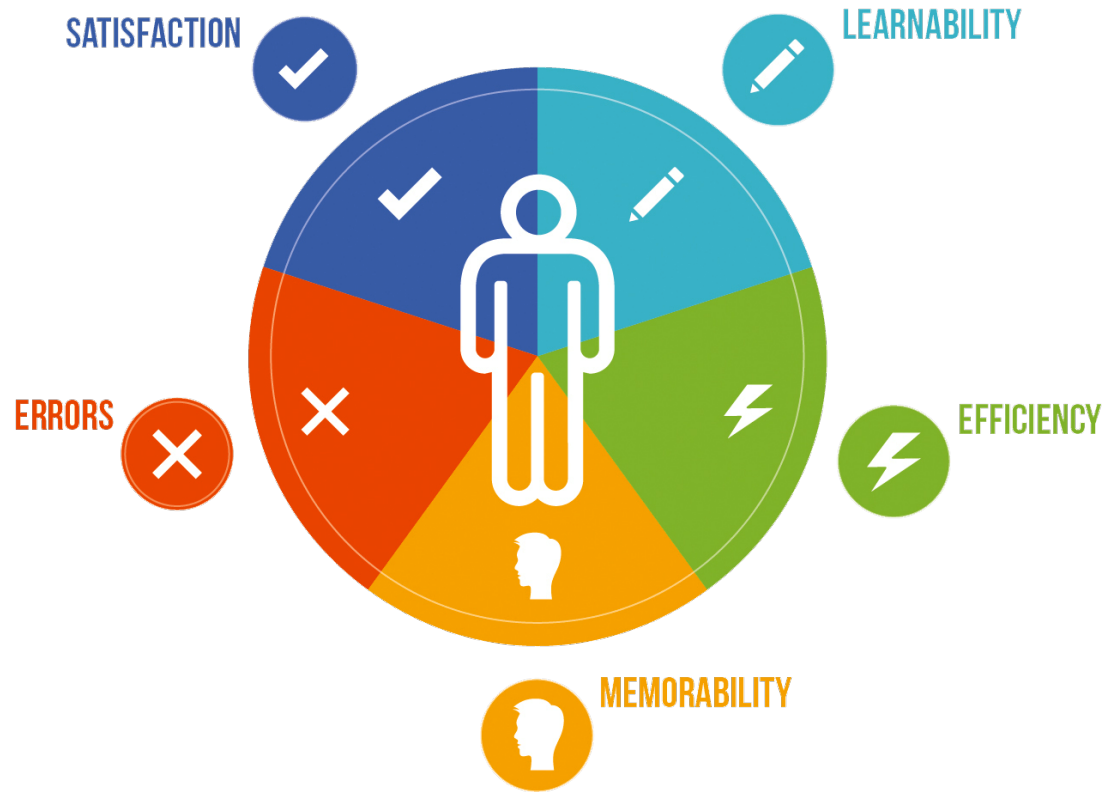
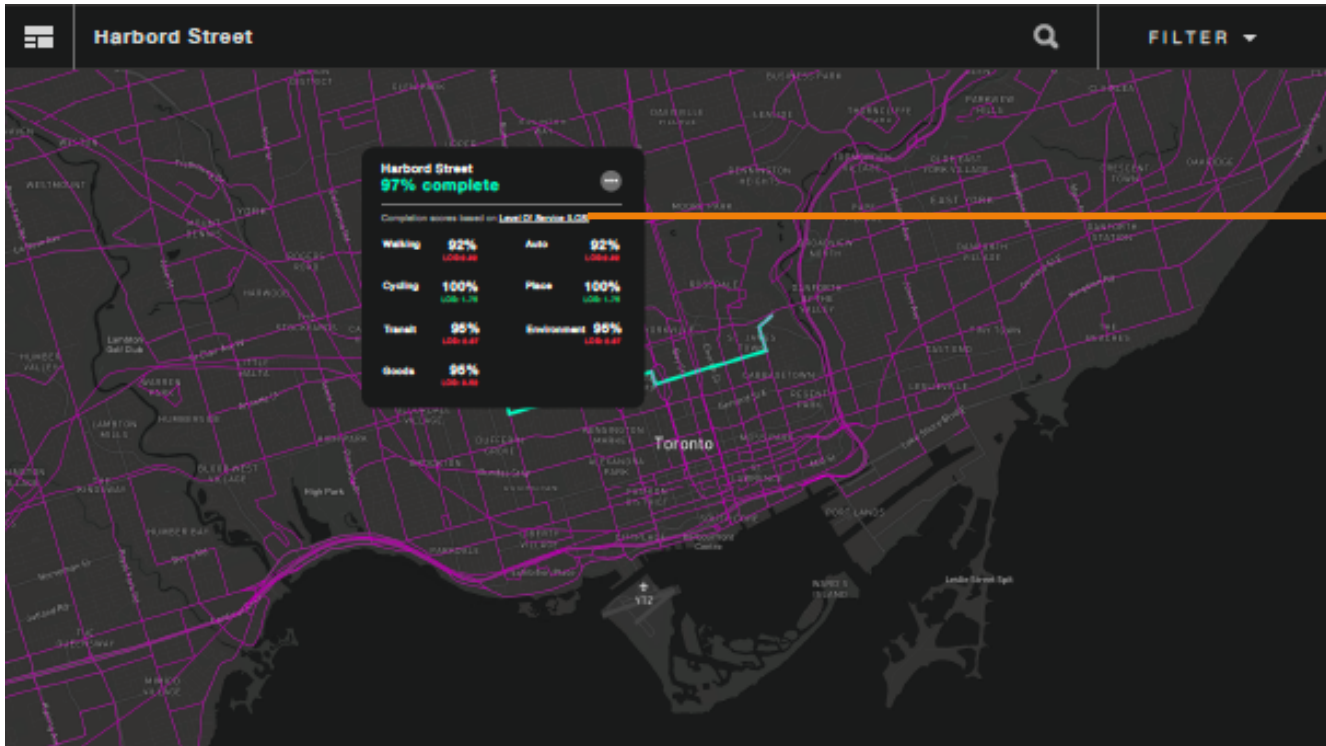


IMAGE: CLIPARTMAX

[Nielsen, 2012]

Principles of Usability



Level of Service Score (LOS)

NCHRP Project 3-70 developed and calibrated a method for evaluating the multimodal level of service (MMLoS) provided by different urban street designs and operations. This MMLoS method is designed for evaluating "complete streets," context-sensitive design alternatives, and smart growth from the perspective of all users of the street. The analyst can use the MMLoS method to evaluate the tradeoffs of various street designs in terms of their effects on the auto driver's, transit passenger's, bicyclist's, and pedestrian's perceptions of the quality of service provided by the street.

The MMLoS method estimates the auto, bus, bicycle, and pedestrian level of service on an urban street using a combination of readily available data and data normally gathered by an agency to assess auto and transit level of service. The data requirements of the MMLoS method include geometric cross-section, signal timing, the posted speed limit, bus headways, traffic volumes, transit patronage, and pedestrian volumes.

Learn more through the [NCHRP Report 616](#)

Principles of Usability

← BACK TO MAP

Harbord Street 97% Complete

Edit Preferences > What is LOS?

WALKING
92% complete
LOS Score: 2.92
LOS Target: 2.75

CYCLING
100% complete
LOS Score: 1.75
LOS Target: 2.5

TRANSIT
95% complete
LOS Score: 2.87
LOS Target: 2.75

GOODS >

← BACK TO HARBORD STREET

WALKING 92% complete

LOS Score: 2.92
LOS Target: 2.75
LOS Grade: C

Literature Review > Edit Preferences >

ASSESSMENT CRITERIA

- Low volume factor
- Average annual daily traffic volume
- Total width of outside lane and shoulder pavement
- Onstreet parking, bike lane, or striped parking
- Onstreet parking offset coefficient
- Percentage of segment with onstreet parking
- Continuous buffer presence
- Buffer area coefficient
- Buffer width (distance between edge of pavement and sidewalk, in feet)
- Sidewalk presence coefficient
- Sidewalk Width
- Directional volume of motorized vehicles in the direction closest to the pedestrian (vph)
- Peak hour factor
- Total number of through lanes for direction of traffic closest to pedestrians
- Average speed of motorized traffic (mph)

Harbord Street

Harbord Street 97% complete

Completion scores based on LOS C2, Section 3.08

Walking	92%	Auto	92%
Cycling	100%	Place	100%
Transit	95%	Environment	95%
Goods	95%		

Harbord Street

← Back to map

OVERALL 97% complete

WALKING	92%	CYCLING	100%	TRANSIT	95%	GOODS	95%	AUTO	95%	PLACE	100%	ENVIRONMENT	100%
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Roadway Specifications

GRASS	BIKEWALK	BUFFER	STRIPED PARKING	BIKE LANE	STRIPED PARKING	CURB CUT	THROUGH LANE 1	THROUGH LANE 2	THROUGH LANE 3	MEDIAN	THROUGH LANE 4	THROUGH LANE 5	CURB CUT	BUFFER	BIKE LANE	STRIPED PARKING	BUFFER	BIKEWALK	GRASS
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Unit: width (meters)

Roadway Information

- How designed for examples of operational roadways only. In reality many elements of road should be assessed iteratively.
- Is there a raised buffer between sidewalk and other areas (e.g. planter, tree)?
- Is there onstreet parking to the curb?
- Is the median actively a 2-way left turn?

Miscellaneous Design parameters

- Aesthetic width:
- Street Classification:
- Street Condition:
- Is street in CBD of a city with population > 5M?
- Are there any obstacles without signal? (If yes, set curb line offset, feet)
- Segment Length:
- Signal Progression Type:

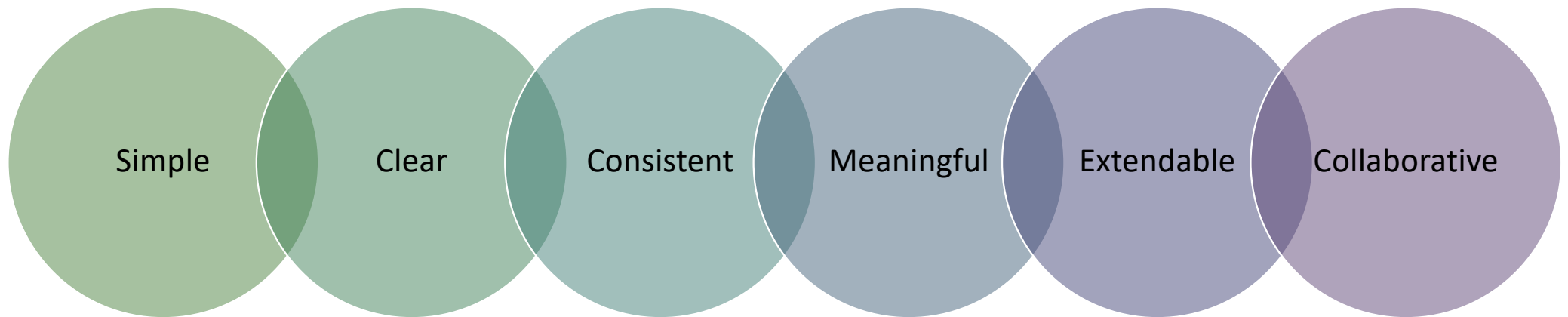
Auto Traffic Flow Parameters

- Posted Speed Limit (mph):
- Average operating speed (mph):
- Peak Hour Factor:
- Peak Factor:
- Directional Factor:
- Percentage heavy vehicles:
- Onstreet parking occupancy:

Transit Flow Parameters

- Max Bussnet:
- Max streetcar:
- Average transit operating speed:
- Transit Headway (minutes):
- Average busload with time on the sidewalk:
- Is bus stop in study section direction with shelter:
- Is bus stop in study section direction with shelter:

User-Centered Design



User-Centered Design

Simple, Clear, Consistent: Function first focus

- Convert complex formulas for urban planning into a simplified engaging user experience
 - Two views: map-based and dashboard
 - Colour use is minimal
 - Interface in black to minimize the load on the eyes
 - Red and green are easily recognizable have been used to denote positive and negative actions.
 - Clean sans-serif fonts have been used
 - Provide visual relief and make it easy to read at all sizes.
 - Common User Interface elements where used
 - Buttons, dropdowns, sliders and checkbox, easily found on most web and mobile interfaces.
- Display information with one touch links with key explanations for theoretical concepts that seem new or unique to a user.

User-Centered Design

Meaningful: Flexibility to browse through streets and draw comparisons between them across areas, before moving into a detailed street redesign or designing a new street

Extendable: Flexibility to add and remove parameters in the future, to adapt to changing laws and amendments

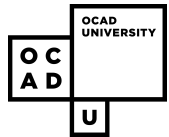
- Ability to be applied across different cities to ensure its future usability

Collaborative: collaborative street design

- Ability to save files and download the data or images from the charts
- Ability to share the saved or downloaded files with other users of the system
- Flexibility to get the data and visualize using other visualization tool
- Future interaction will include collaborative design inside the tool

Complete Streets Dashboard

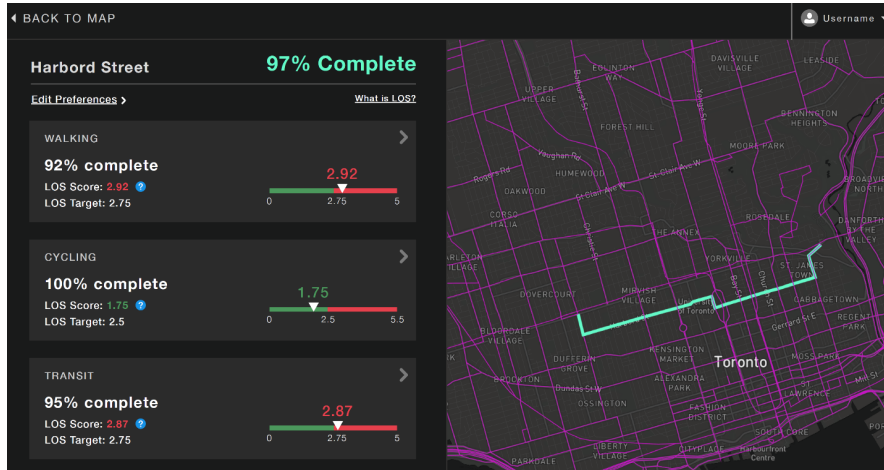
Demonstration



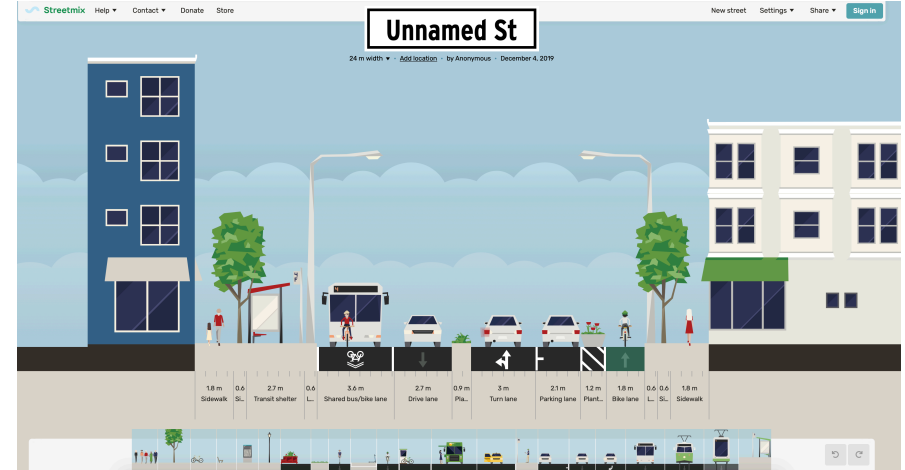
Conclusions

- Kept the initial proposal of the dashboard, improving:
 - Application:
 - Changed from spreadsheet to an web application
 - Created a map-based visualization tool with a dashboard view
 - Inclusion of users interactions
 - Consistent and cleaning navigation
 - Kept the spreadsheet data format to be adapted to other cities in the future
 - User Experience:
 - Inclusion of interactions both in map-level and visualization level
 - Inclusion of references to understand the data
 - Possibility to create different scenarios and save to future evaluation or to share with other stackholders
 - Possibility to save and download data or image to share with stackholders
 - Possibility to compare different scenarios for a same street or between streets from same neighbourhood
 - Clean visualization

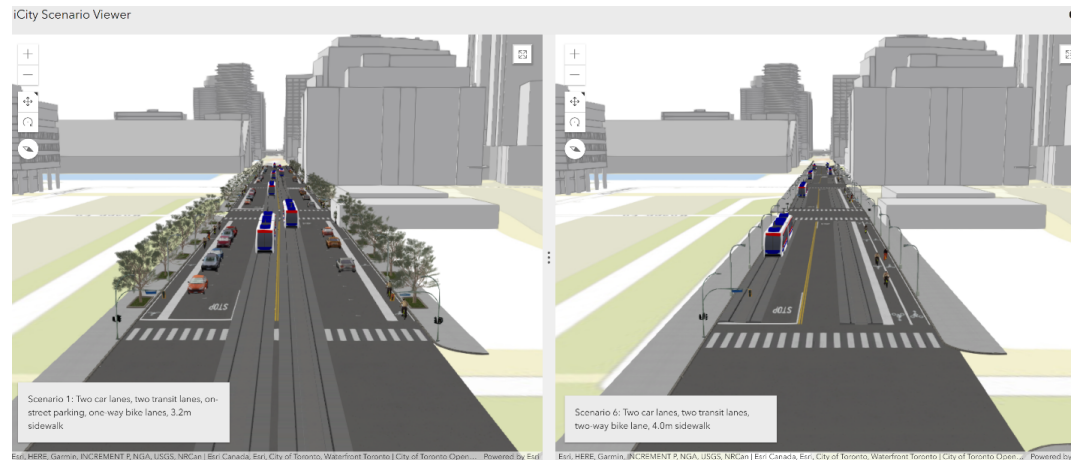
Next Steps



Current Prototype developed by OCAD team



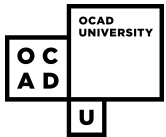
Streetmix 2D cross-sectional complete streets tool



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

Acknowledgments

- University of Toronto
- Canada Foundation for Innovation,
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- NSERC Canada CreateDAV,
- MITACS



Thank You!



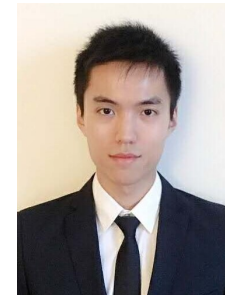
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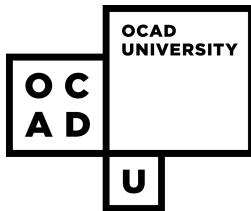
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Prof. Jeremy Bowes



Prof. Dr.
Sara Diamond



Prof. Dr.
Matthew Roorda



References

- Katsumi, M. & Fox, M.: [The iCity Ontology: Towards a Data Standard for Transportation Planning](#). iCity-ORF Research Days Webinar Series. Ontologies & Platforms: June 8, 2020 (2020)
- Hui, N., Saxe, S., Roorda, M., Hess, P., Miller, E.: Measuring the completeness of complete streets. *Transp. Rev.* 38, 1–23 (2017)
- Nielsen, J.: Usability 101: Introduction to Usability. Nielsen Norman Group (2012). <https://www.nngroup.com/articles/usability-101-introduction-tousability/>. Accessed 26 Jan 2020
- Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S.: *Designing the User Interface: Strategies for Effective Human-Computer Interaction*, 6th edn. Pearson, London (2016)
- Reynolds, G.: *Presentation Zen Design: A Simple Visual Approach to Presenting in Today's World*, 2nd edn. Pearson Education, London (2014)

- More references are available in our paper.