

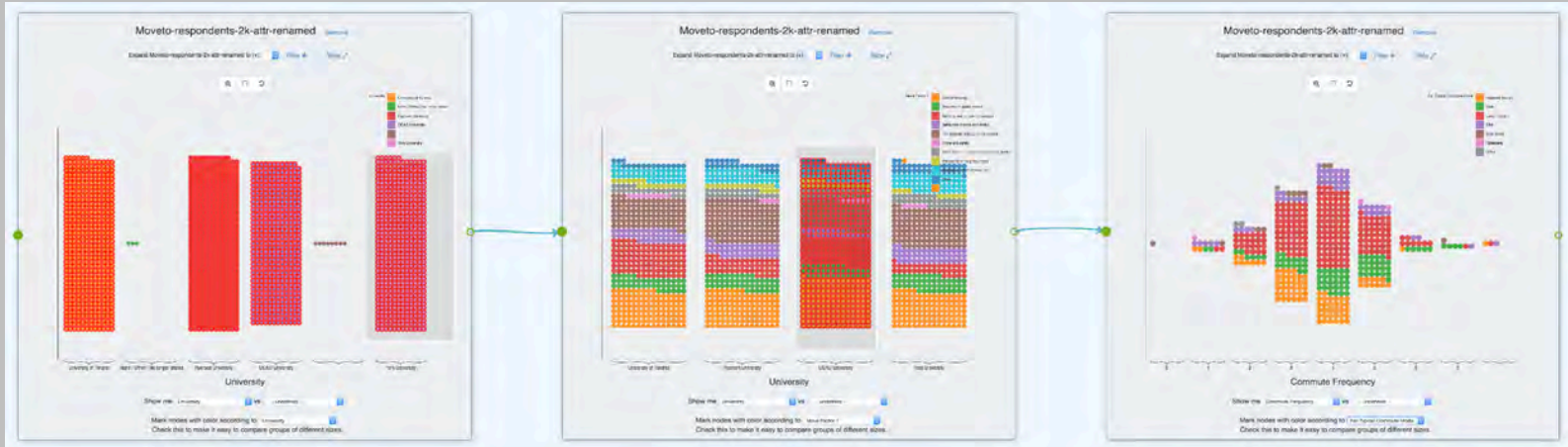
**2D & 3D Tools for Urban
Analytics
Dr. Sara Diamond & Jeremy
Bowes**

2D – 3D Team

Sara Diamond, Cody Dunne, Jeremy Bowes,
Carl Skelton, (Davidson) Minsheng Zheng,
Michael Carnivale, Martin Kaplin, Jee Won
Kim, Nanini Lee Baalki, Marcus Gordon

Understanding Appropriate/Integrated Use of 3D; Cartography; 2D

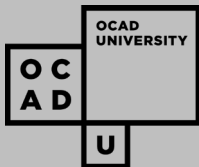
- 2D representations – place data in context – graphs and volumes
- 3D – volumetric visualization, multivariant factors – use with care and maintain perceptual capacity (Carpendale, 2001)
- Cartograms (Nusrat, 2018) interpret data encoded in cartograms, cardinality – where does the task operate in the data?
- Multiple visualization strategies to interpret different qualities of the data and allow comparative inferences.



Visual Analytics StoryFacets

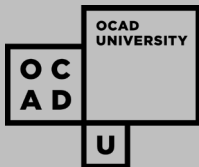
StoryFacets - Overview

- Visual exploration and presentation system for relational data – collaboration with IBM
- An enhanced version of GraphTrail
- One source, multi-media
- Explore with provenance
- Collaboration-minded and communication-centered design, suited for transportation planning
- Multiple views of a data analysis session (Trail, Dashboard, and Slideshow)
- iCity collaboration new - csv file import and data modelling



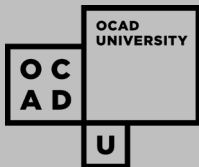
Goals

- Enhance the quality and the performance of the web-based visualization prototype, StoryFacets
- Design and implement additional features
- Provide technical support to the user studies of StoryFacets
- Provide technical support to comparative studies between visualization systems, Betaville and StoryFacets, on urban transportation data



Goals

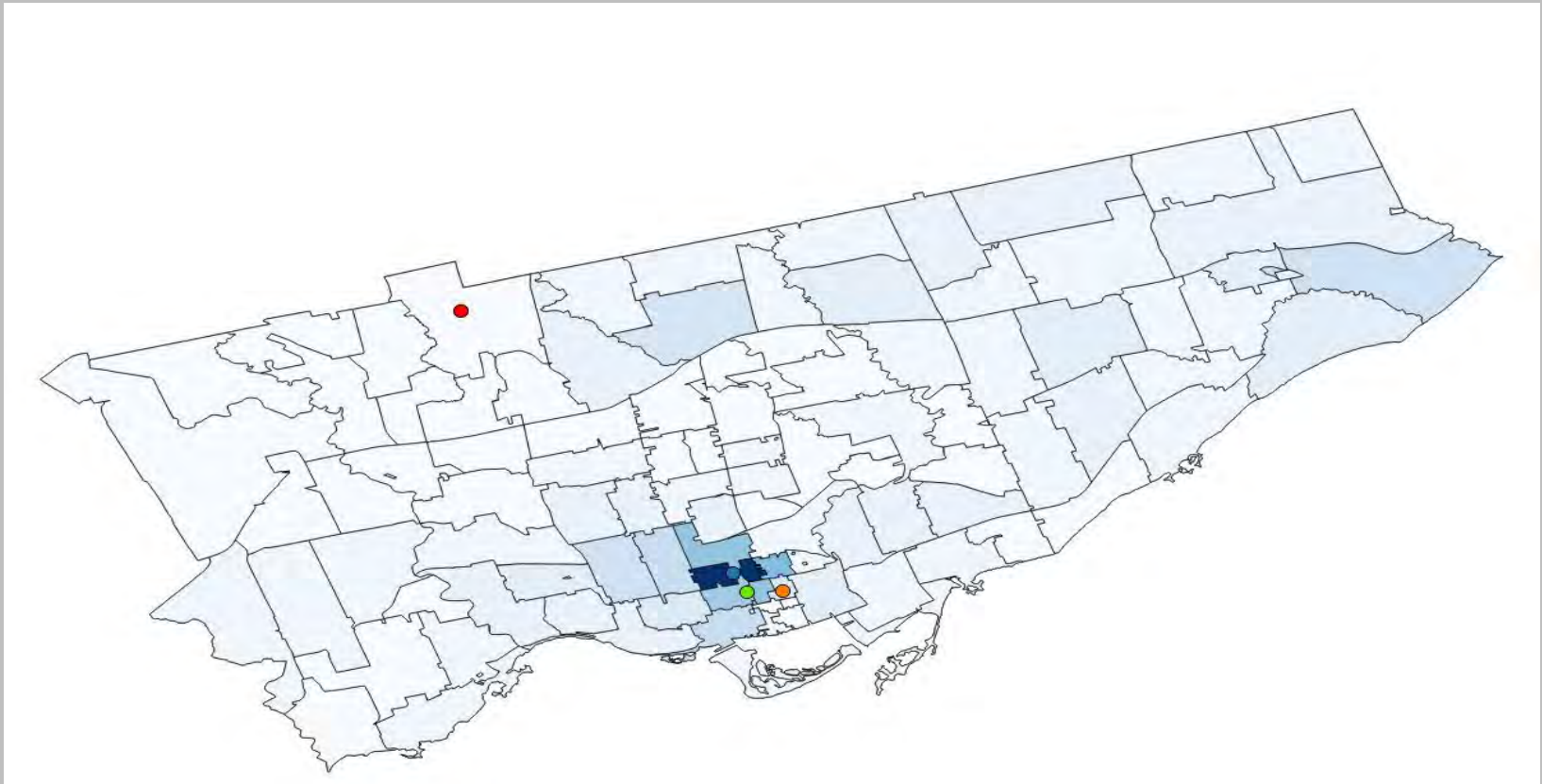
1. Data collection and loading
2. App performance tuning
3. Integration of exploration annotation and qualitative data (trail markdown card)
4. Implement general purpose data import (.csv file)
5. Manage relationship between datasets



Theme 3 Visual Analytics: 3D, cartographic, timebased

Goal – Prepare data for Betaville visualization prototypes

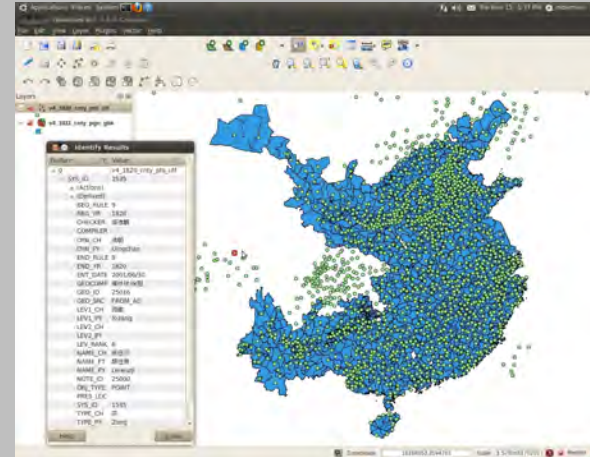
- GIS – Geographical Information Systems
- Data Collection
- Data preparation & import
- Visualization



Geographical Information Systems: Betaville goals

Basic Concepts

- Spatial Data
- Attributes
- Coordinate Systems



- Open source
- Standard GIS tools
- Plug-in capability

- Proprietary (ESRI)
- Gold-standard GIS
- Combines with other ESRI software

Betaville, Carl Skelton & Thorsten Teshkle

- the potential for an open source software architecture to support broadly based collaborative participation in the planning and design aspects of local governance in specific
- 3D visualization of proposed designs in context, and the synthesis of quantitative and qualitative information and decision support
- ArcGIS Pro - integrating ESRI extensions directly with Betaville

new proposal

PROPOSAL TITLE

PROPOSAL DESCRIPTION

ADDRESS (optional)

WEBSITE URL (optional)

new version of existing design

[Click on the model you want to update]

VERSION DESCRIPTION

● ● ● ● ● **Next**

No Title

Move Speed: 1

Rotation: 0

Move North Move South

Move Up

Cancel

Performance ✕

Frames Per Second: 30

Triangles in Scene: 349k

Triangles in Selected: 81k

✓ Round FPS ✓ Round Triangle Count

PROPOSALS | **VERSIONS**

Maglev Station (1)
Bud Griffis

Liberty Piers (3)
B-Ville Crew

1

City nade

Liberty Piers Version 2
a (very) mixed-use development

Liberty Piers Version 3
a (very) mixed-use development, with much-needed flora



Information	
name	
Whitman Bikeway	
address	
Brooklyn Bridge	
description	
Infrastructure with a trace of play	
url	
None	
Uploaded By: Carl	<input type="button" value="Close"/>

Layer name
OCAD_Postal

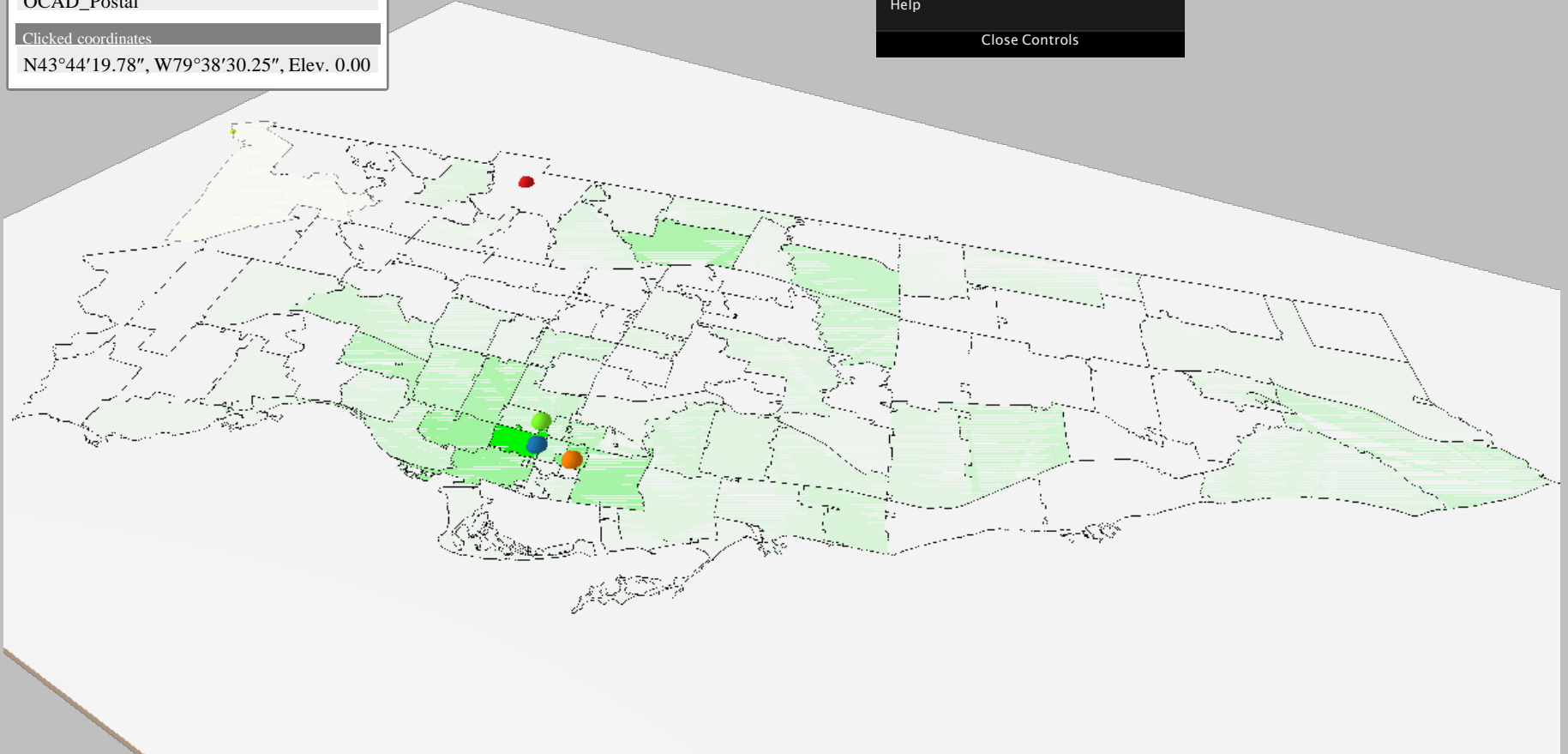
Clicked coordinates
N43°44'19.78", W79°38'30.25", Elev. 0.00

Layers

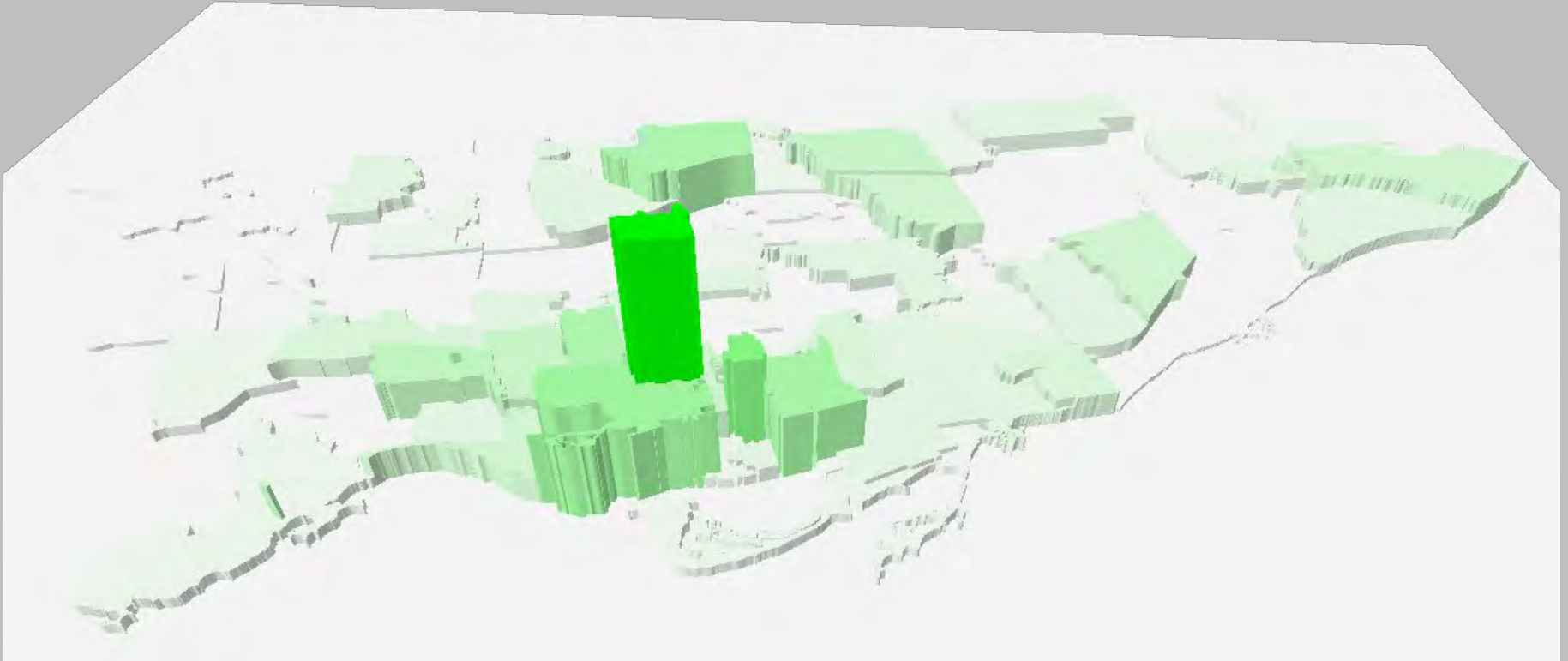
Custom Plane

Help

Close Controls



- Layers
- Custom Plane
- Help
- Close Controls



Data Collection

Toronto OpenData Repository



<http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=9e56e03bb8d1e310VgnVCM10000071d60f89RC>
[RD](#)

- Statistics (.xls, .csv)
 - E.g., Health, culture, recreation, economics, real-estate, demographics, etc.
- Spatial data (.shp)
 - E.g., police regions, postal code regions, addresses, buildings, streets, parks, etc.

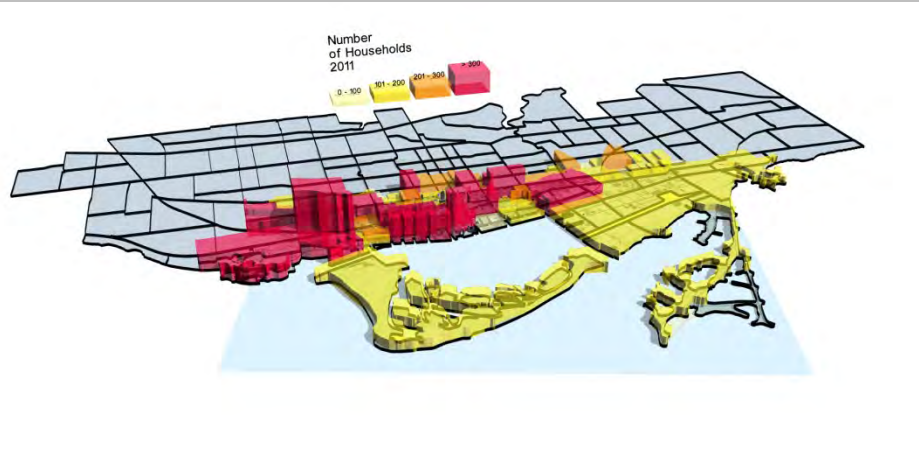




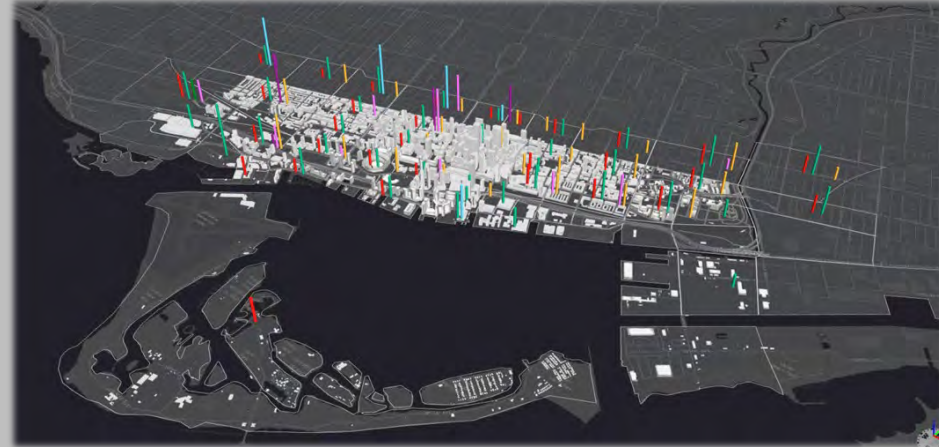


Data Visualization

Number of Households



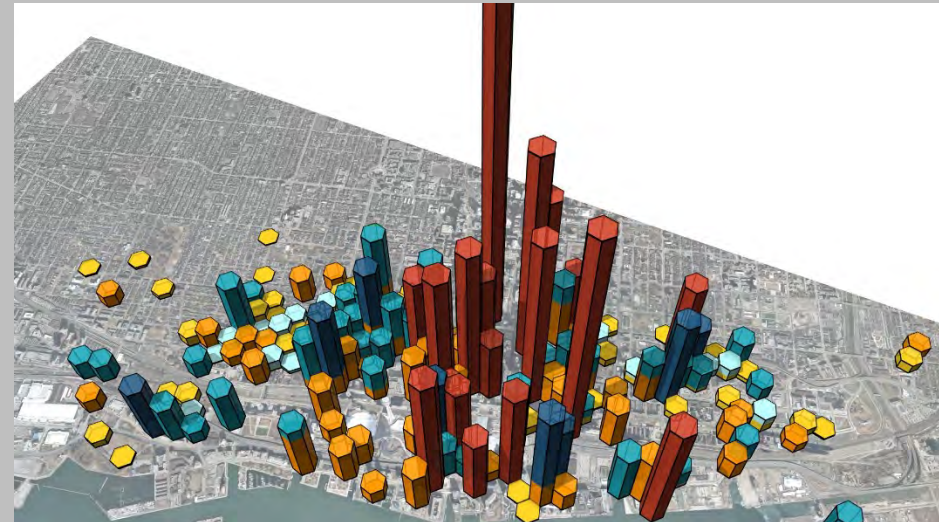
Student MoveTO Survey



Building Zoning Heights

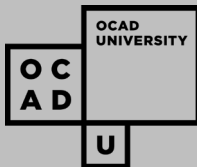


Parking Availability



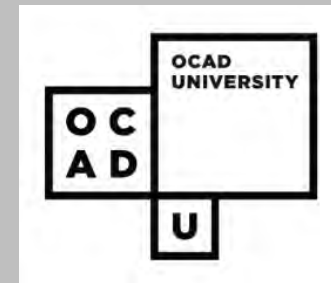
Case Study – Exploring Student MoveTO Data

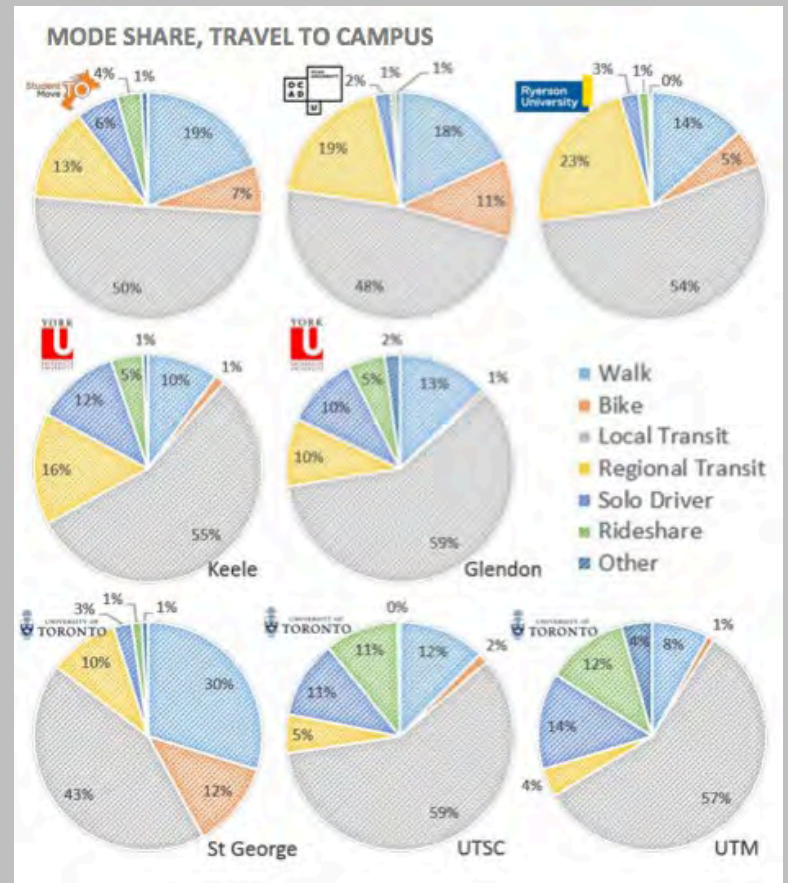
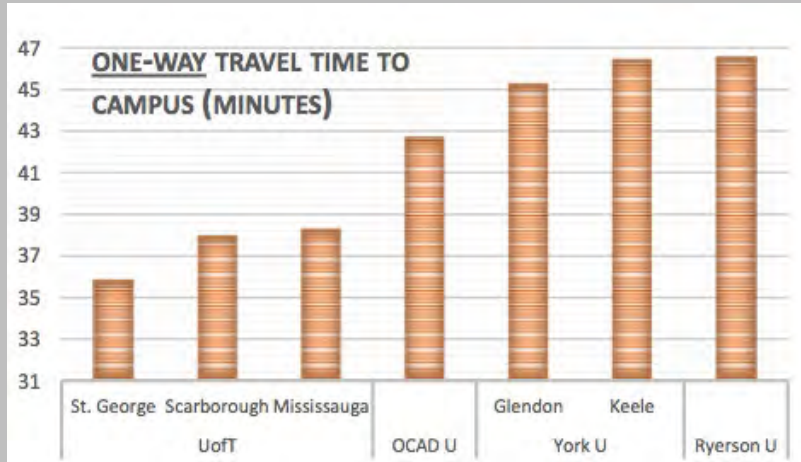
- ~15k responses
- Fall 2015
- Where students live and travel
- What influence how they schedule daily activities





- 2015 Survey
- Where do students live and travel?
- What factors influence how they schedule work, studies, and daily activities?





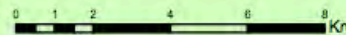
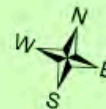
City of Toronto Priority Areas with Forward Sortation Areas



Legend

- Forward Sortation Area (first 3 digits of postal code)
- Priority Area
- Major Arterial Street

Notes: The priority areas are composed of neighbourhoods, neighbourhood areas (two or more joined neighbourhoods) and one special area (Kingston-Galloway) which is built out of Statistics Canada Dissemination Areas (DAs). For information on all the City's 140 neighbourhoods, please visit <http://www.toronto.ca/demographics/neighbourhoods.htm>



Source: City of Toronto; Canada Post
 Copyright City of Toronto 2009. All Rights Reserved.
 Date of Publication: May 2009
 Prepared by: Social Policy Analysis & Research
 Contact: spar@toronto.ca

Canada_by_Postal_Code_Shapefile + QGIS

Identify Results

Feature Value

gfsa000b11a_e

PRNAME	Manitoba
(Derived)	
(Actions)	
CFSALUID	ROB
PRUID	46
PRNAME	Manitoba

Mode: Current layer Auto open form

View: Tree Help

Layers Panel

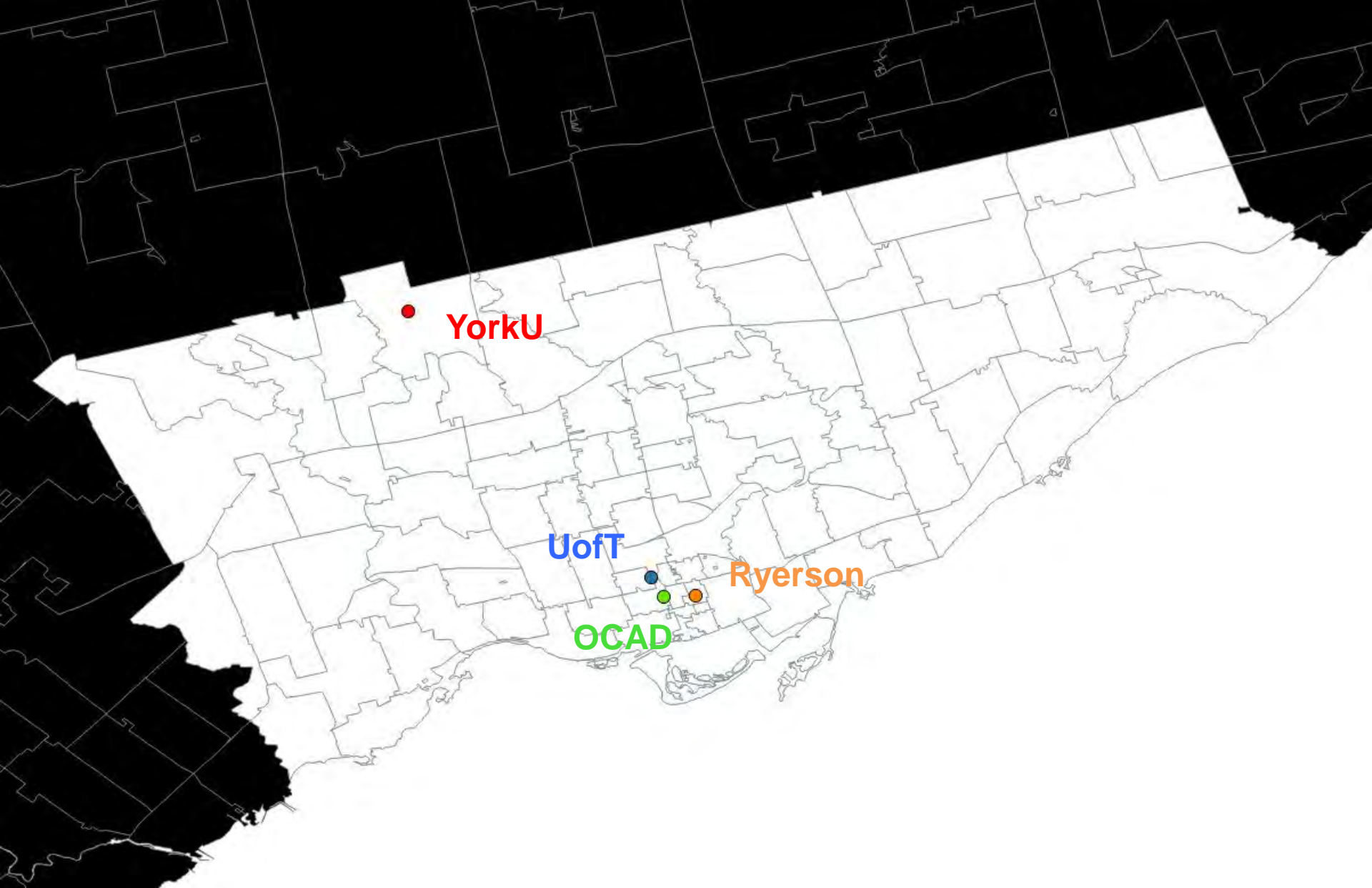
- YorkU_Point
- OCAD_Point
- Ryerson_Point
- UoFT_Point
- UniversityPoints
- School_2
- UoFT
- OCAD
- Ryerson
- YorkU
- PostalAreas_FSA copy copy
- gfsa000b11a_e**
- NEIGHBORHOODS_WGS84

Coordinate: -141.53,70.63 Scale: 1:7,472,595 Rotation: 0.0 Render EPSC:4326 (OTF)

Attribute table - gfsa000b11a_e :: Fe

	CFSALUID	PRUID	PRNAME
1598	P7B	35	Ontario
1599	P7C	35	Ontario
1600	P7E	35	Ontario
1601	P7G	35	Ontario
1602	P7J	35	Ontario
1603	P7K	35	Ontario
1604	P7L	35	Ontario
1605	P8N	35	Ontario
1606	P8T	35	Ontario
1607	P9A	35	Ontario
1608	P9N	35	Ontario
1609	R5H	46	Manitoba
1610	ROA	46	Manitoba
1611	ROB	46	Manitoba
1612	ROC	46	Manitoba
1613	ROE	46	Manitoba

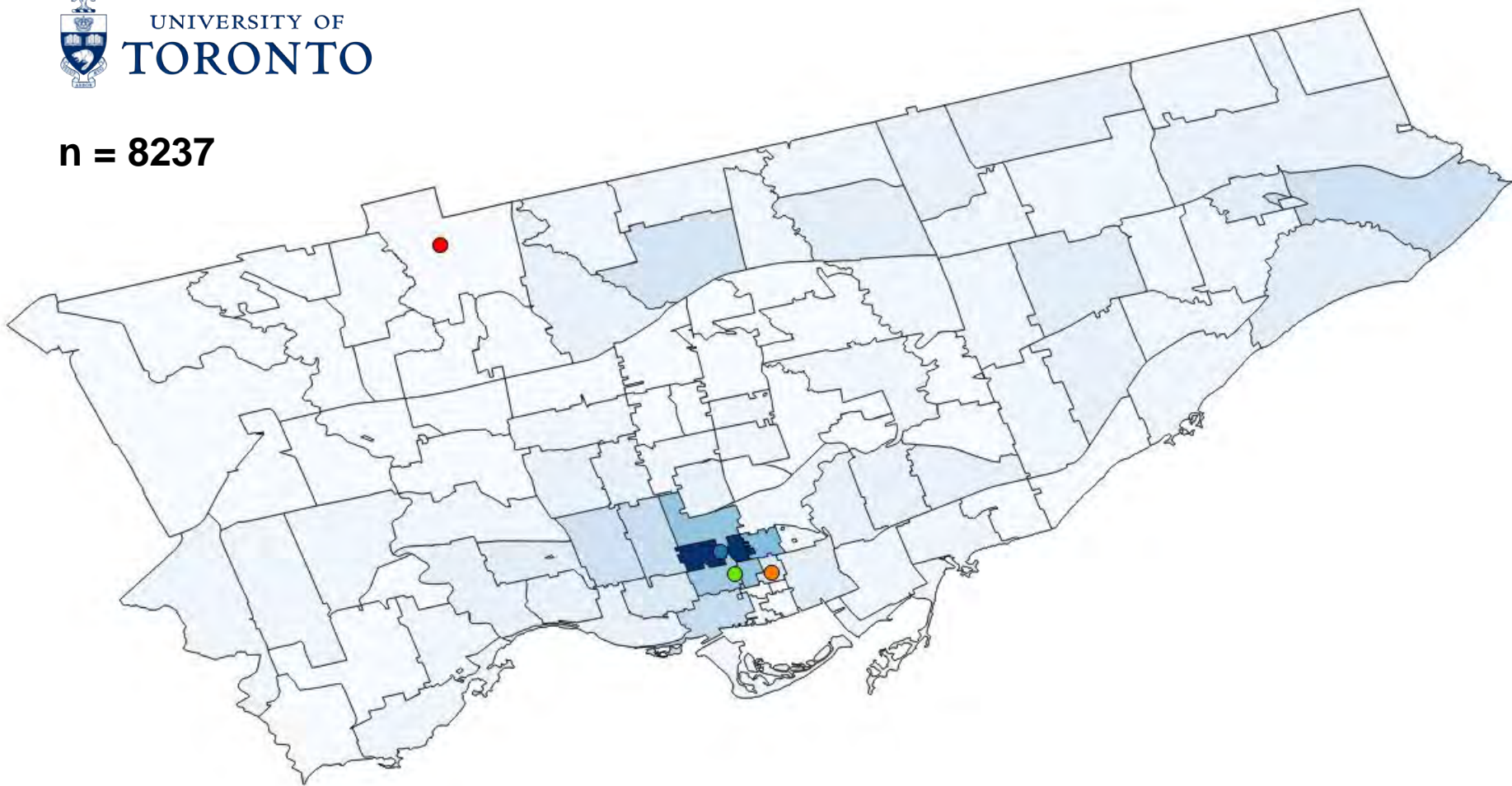
Toronto_by_Postal_Codes + University_Locations



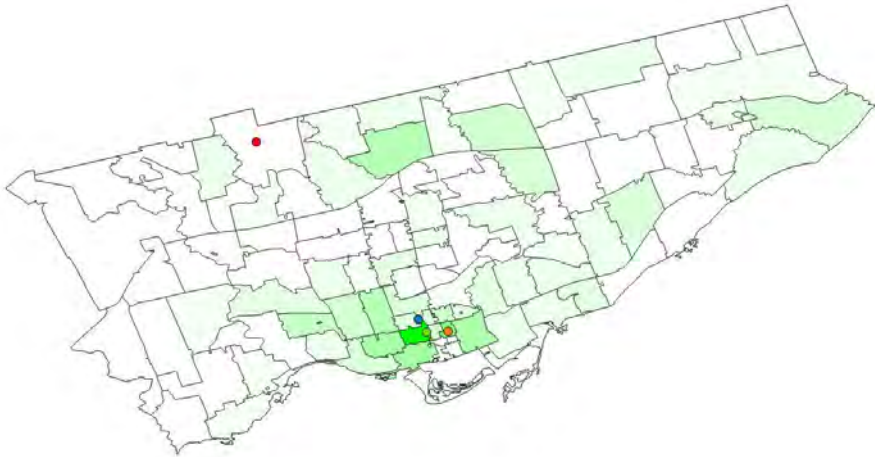
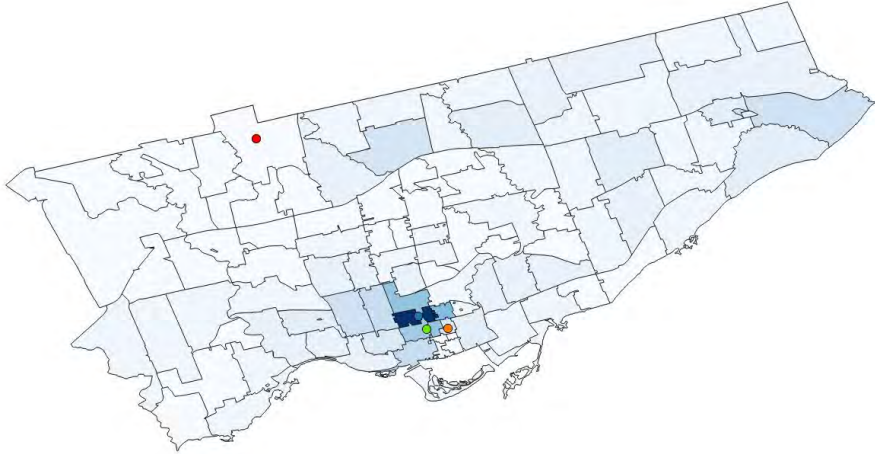
Relative Density of UofT Students living in each P. Code Region



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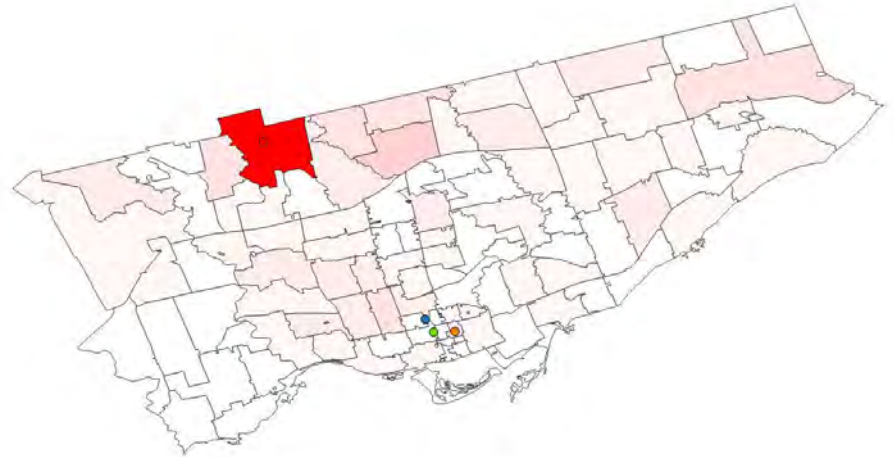
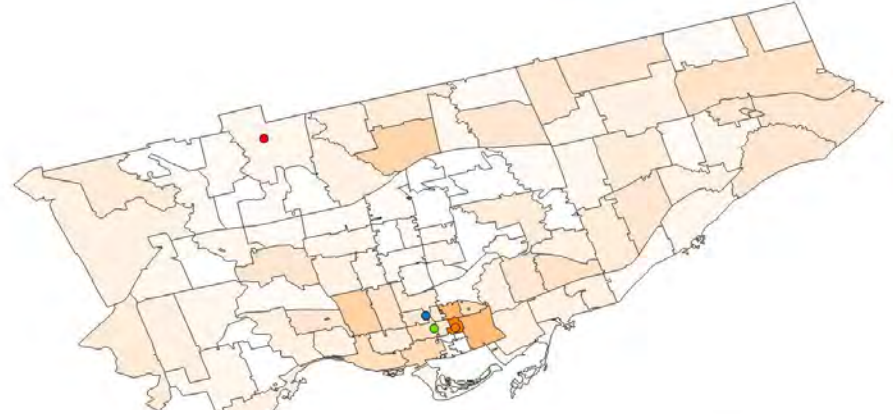


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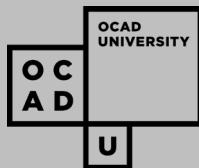
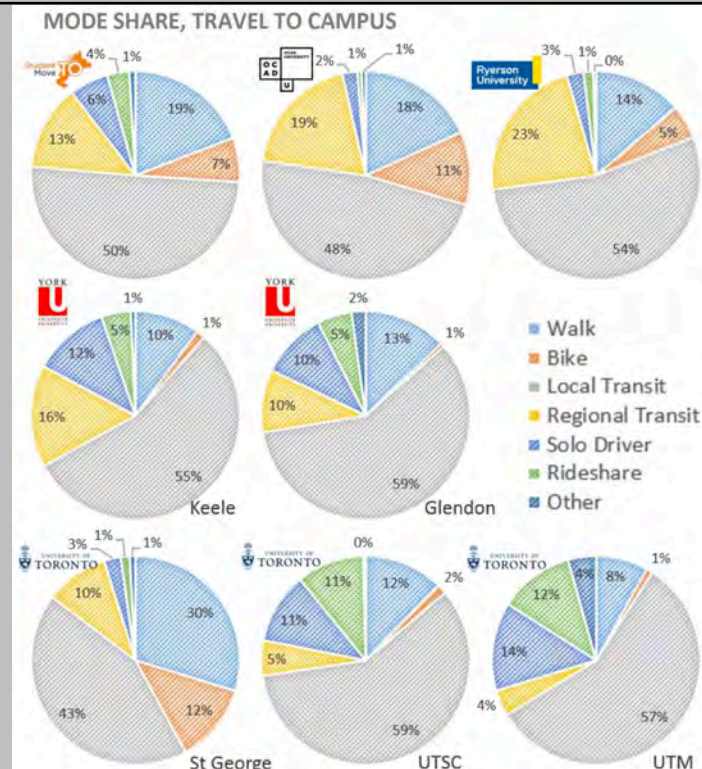
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n = 2922

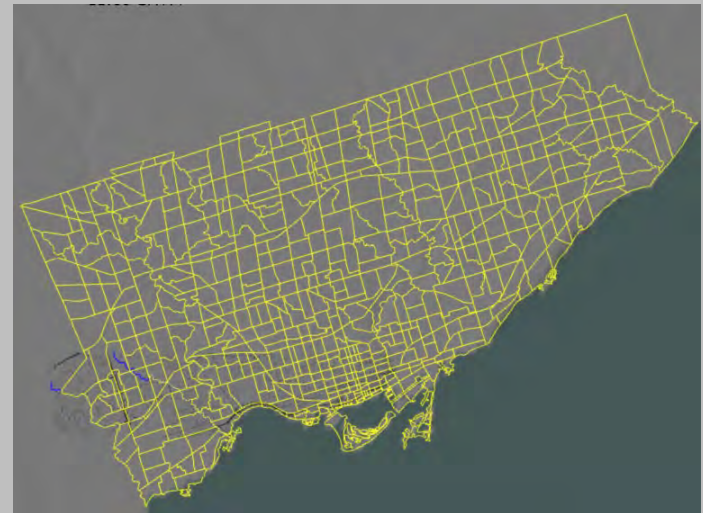
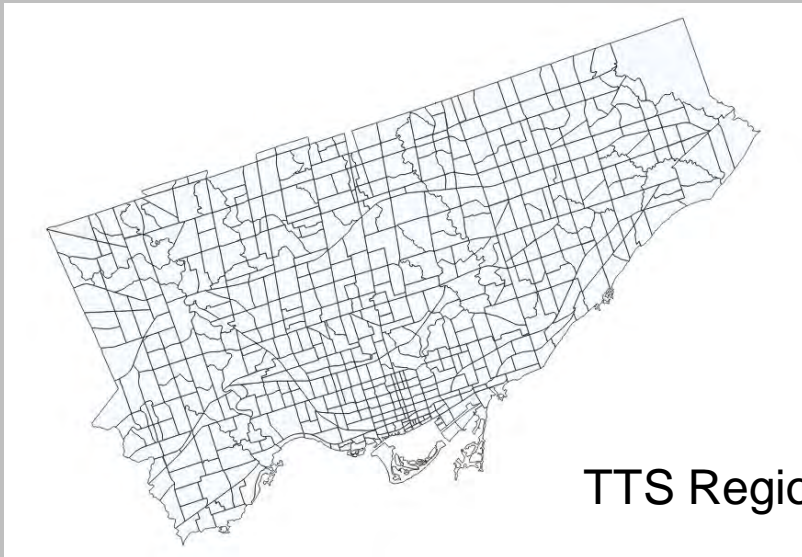
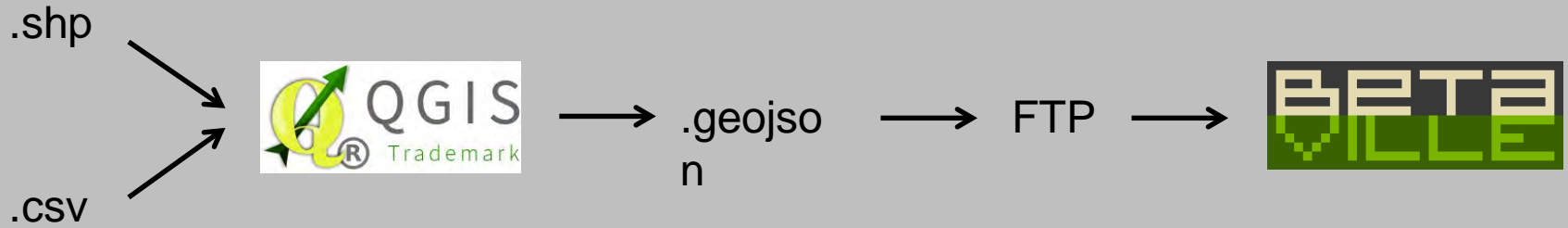


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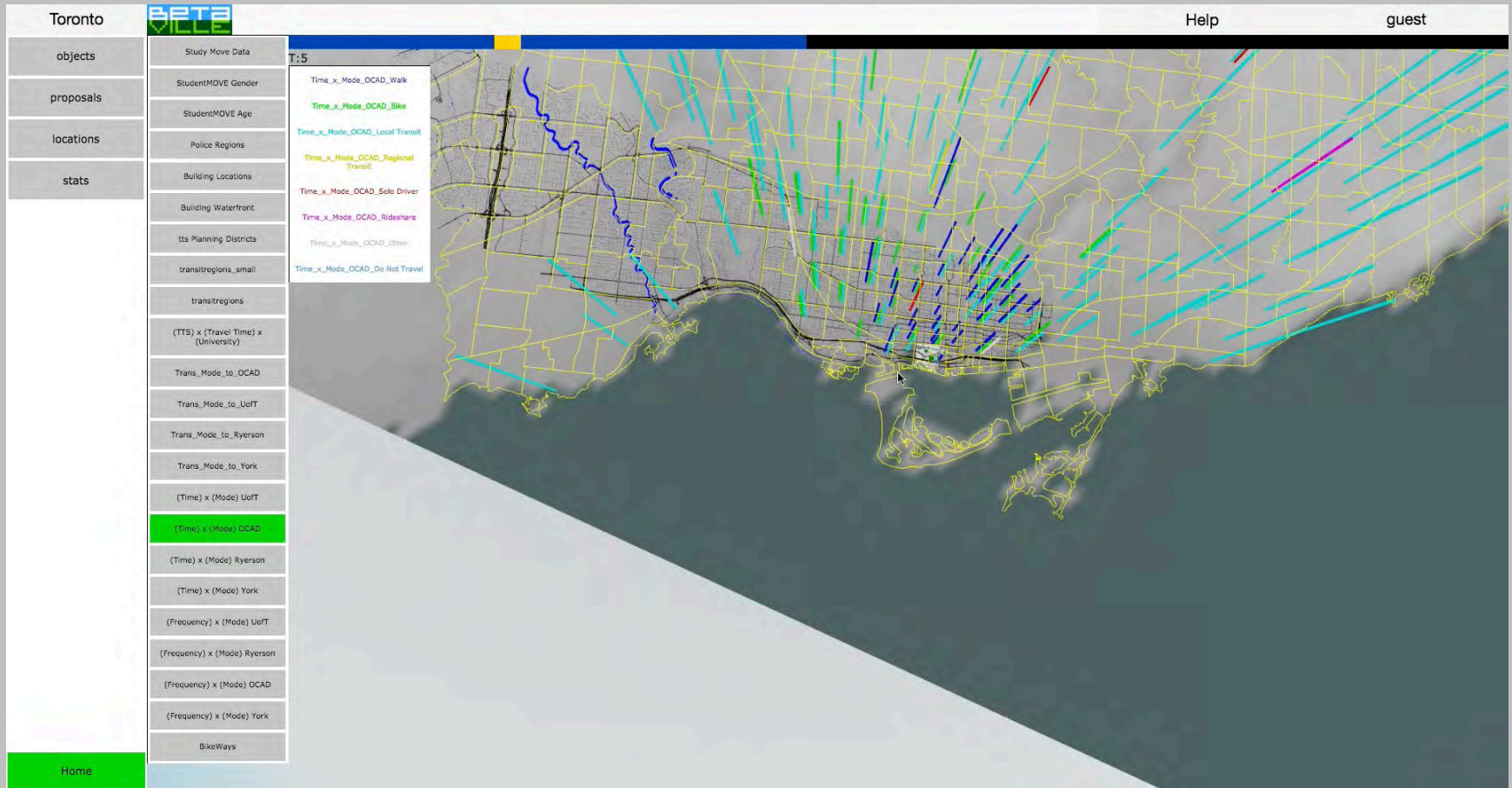
Student MoveTO Visualizations



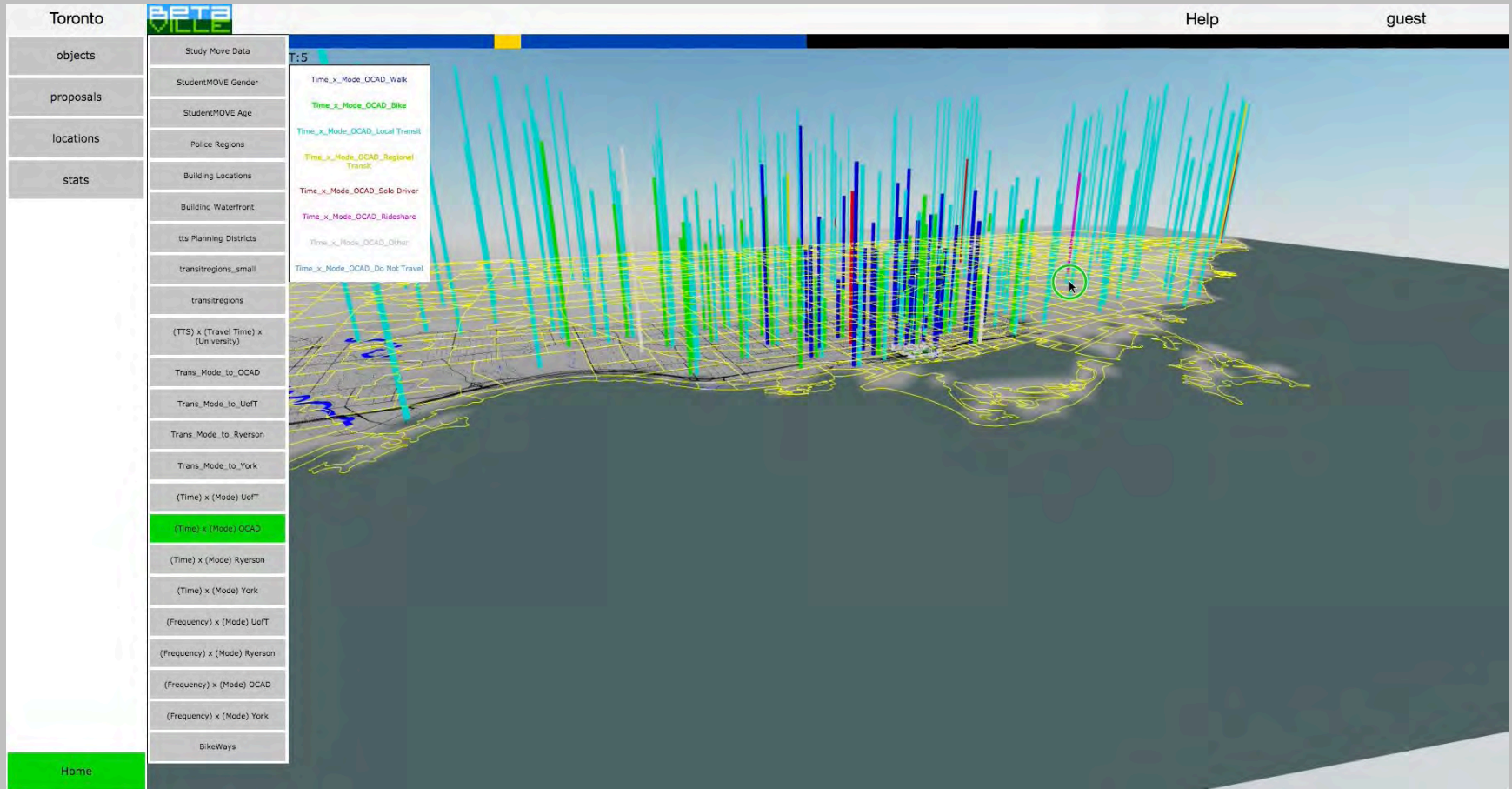
Data Preparation and Importation



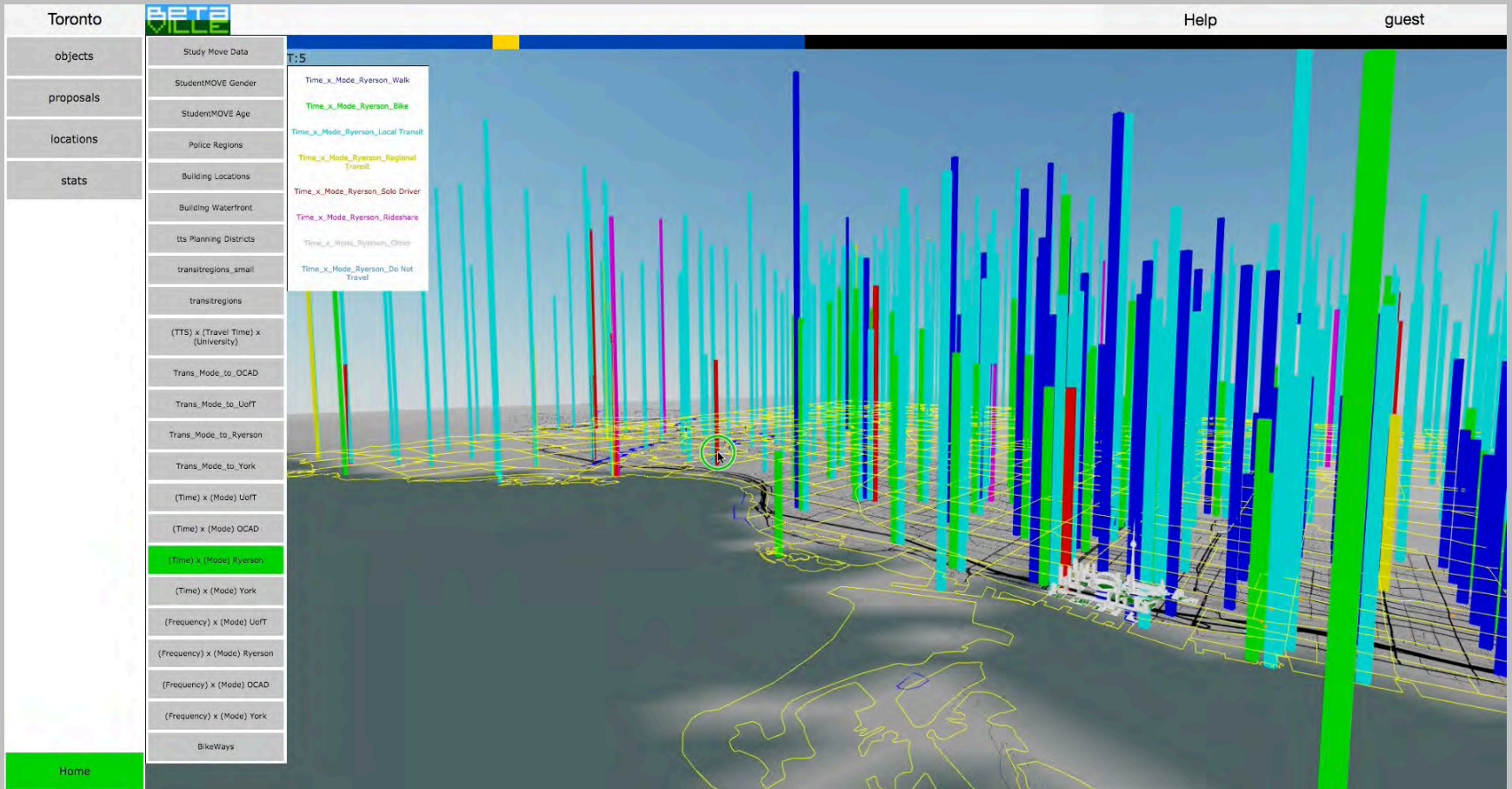
Betaville Time Mode OCAD U



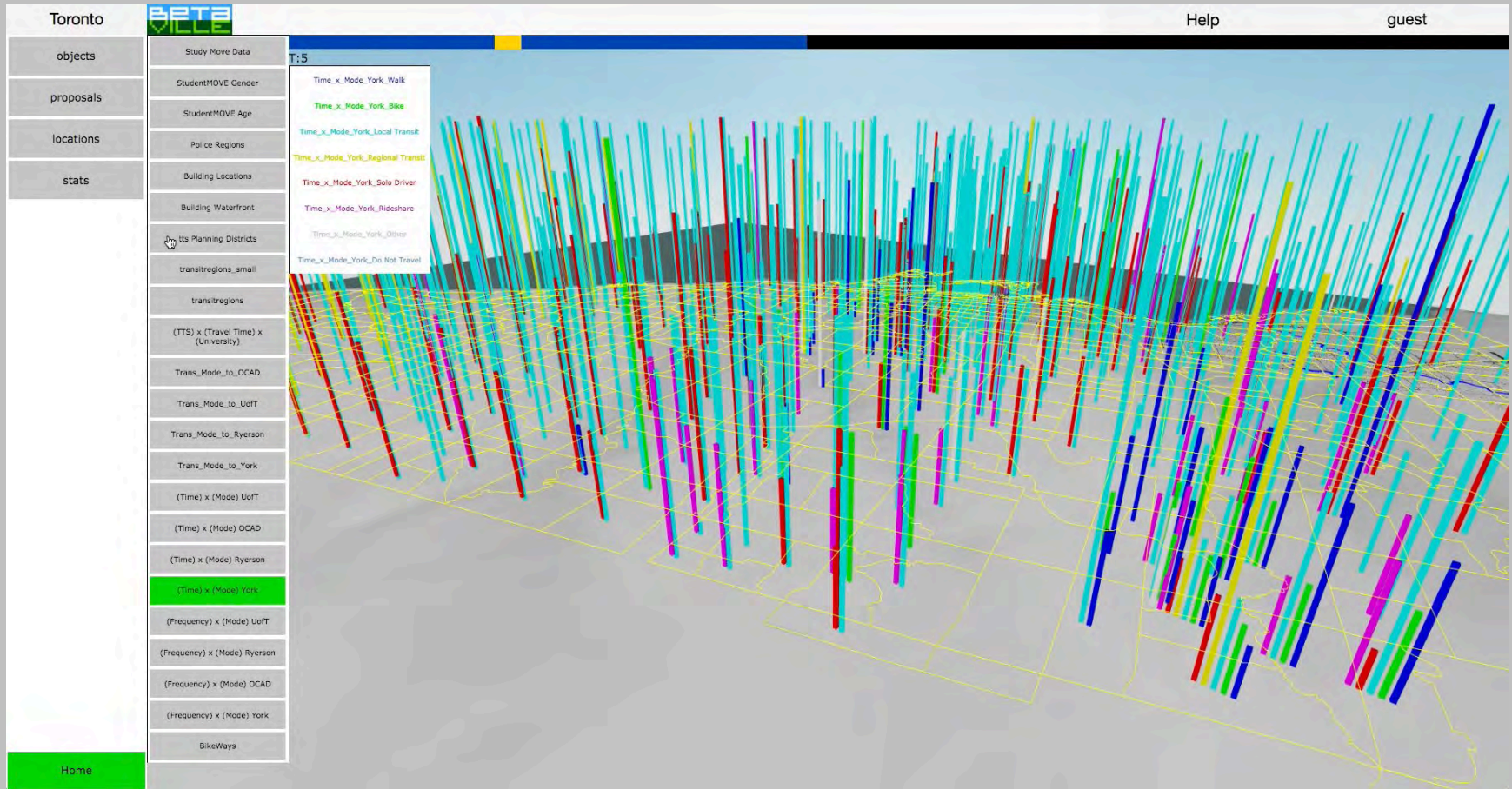
Time Mode OCAD U



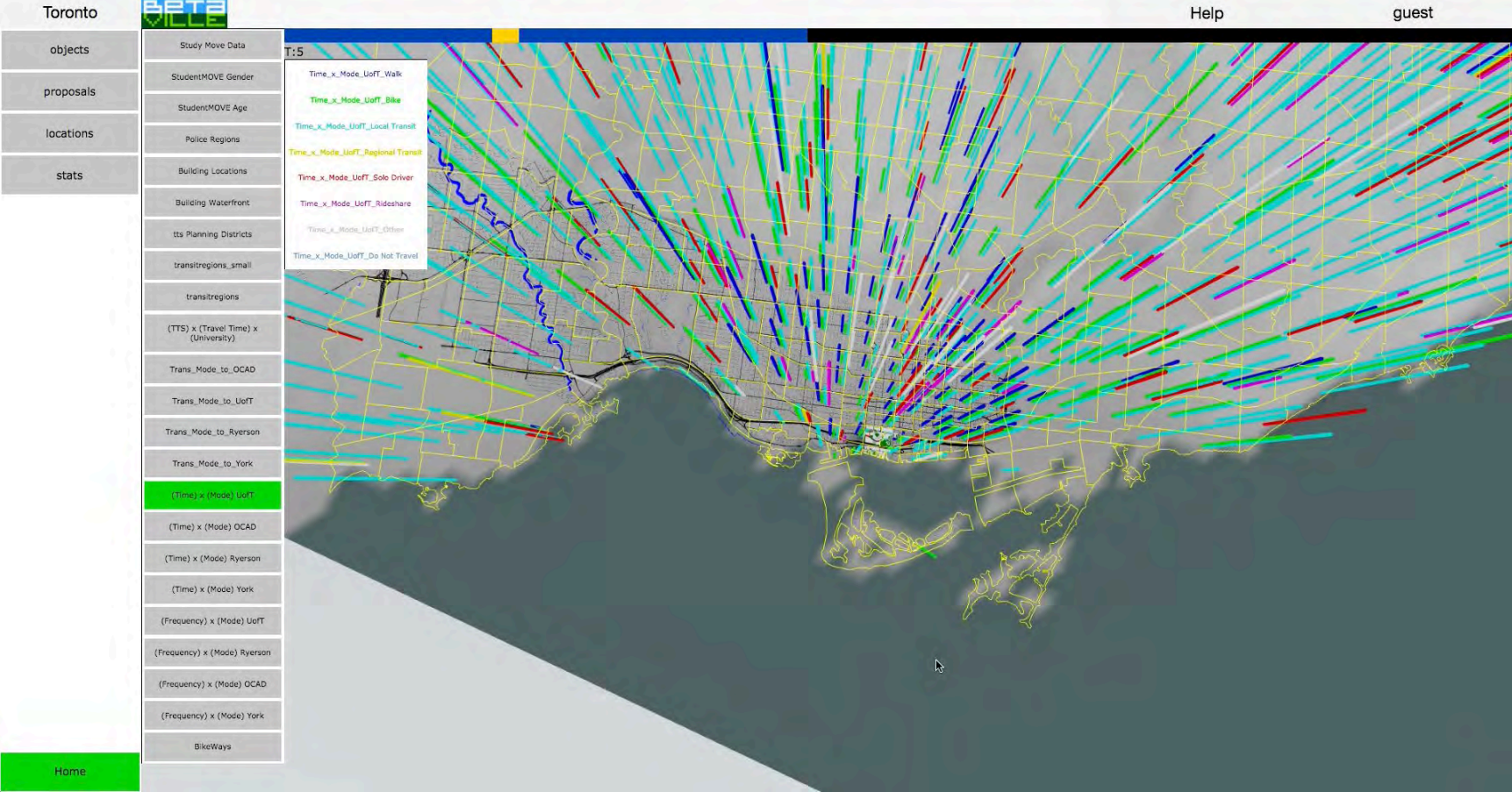
Time Mode Ryerson



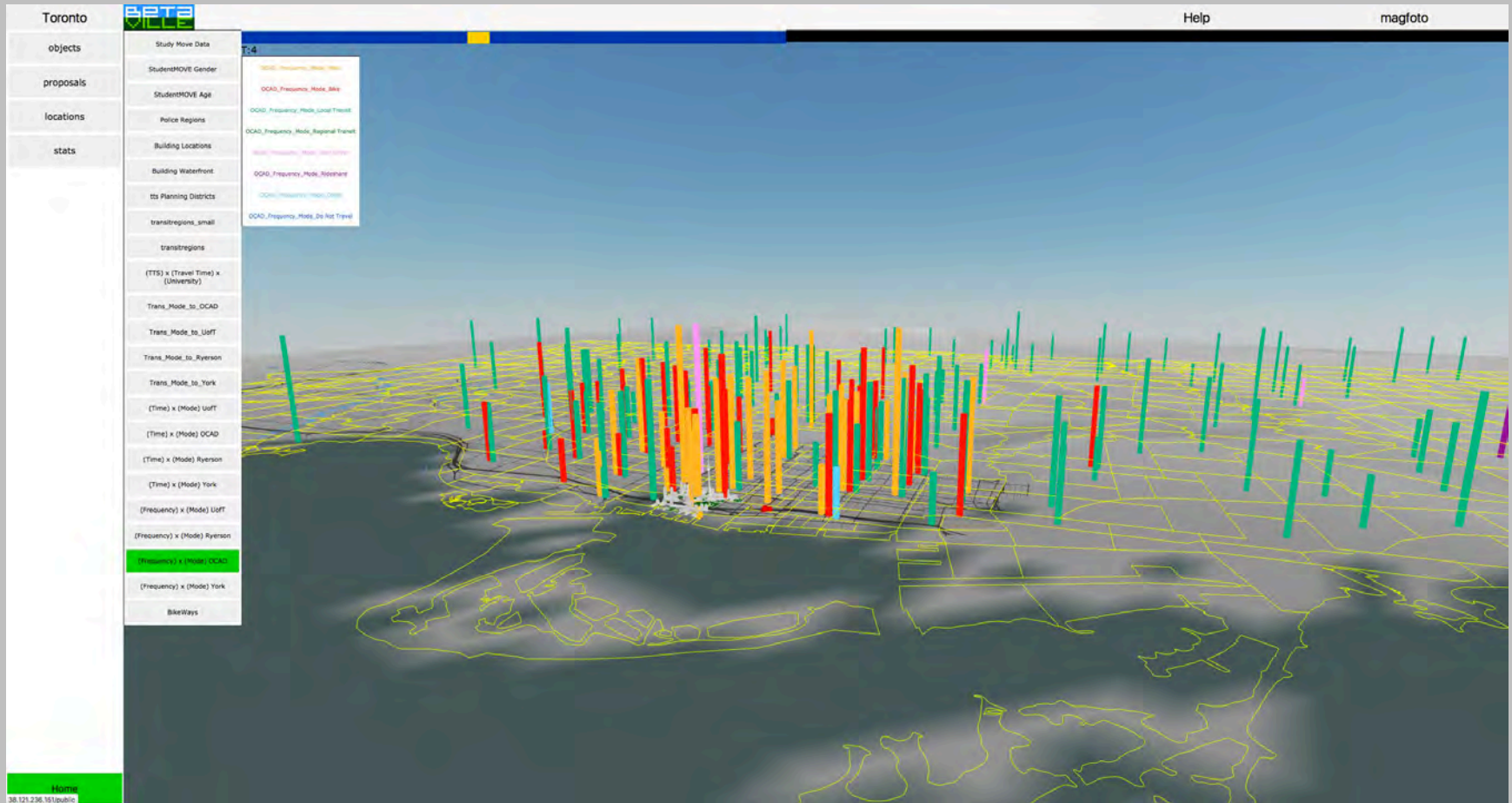
Time Mode York



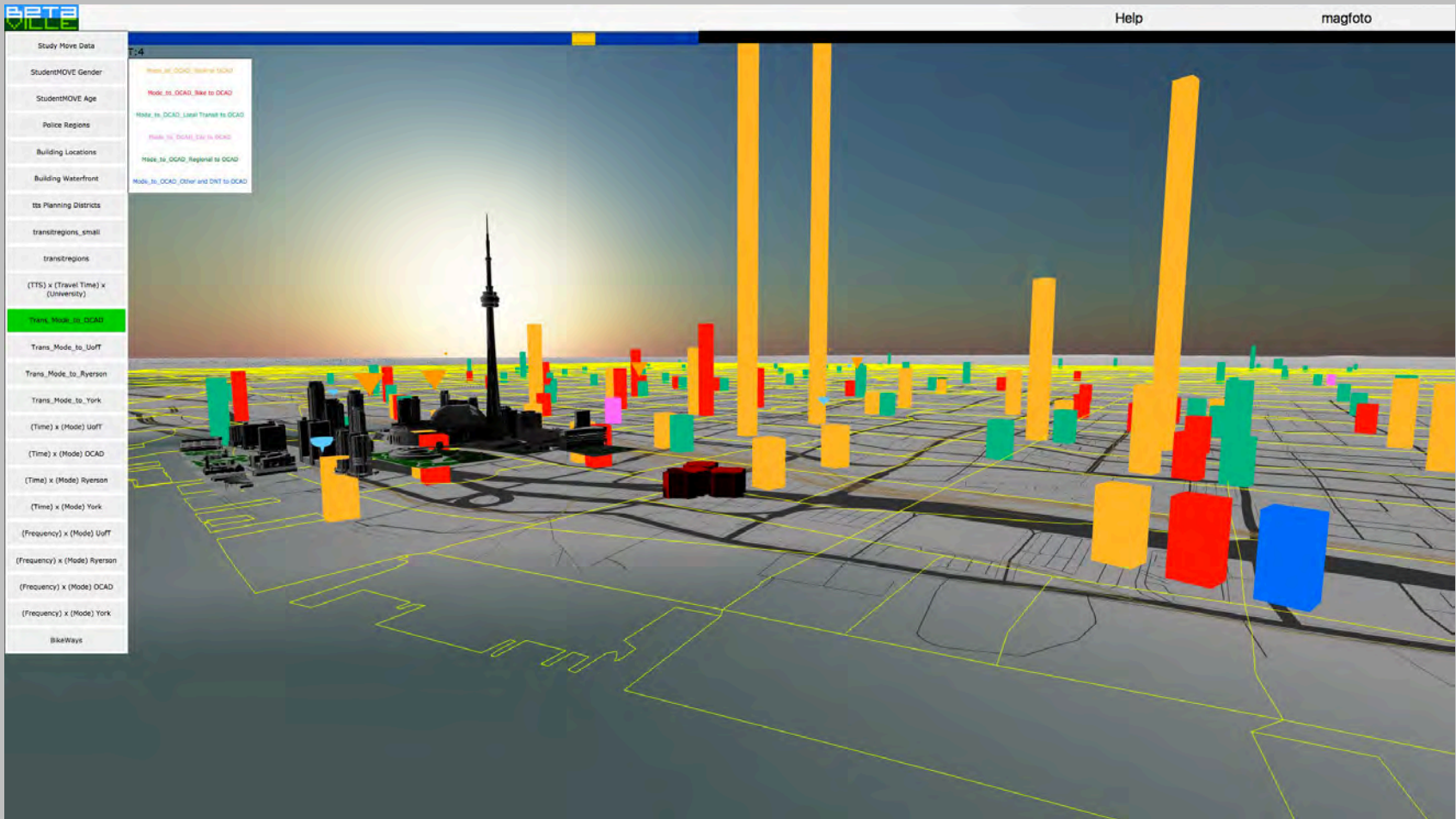
Time Mode U of T



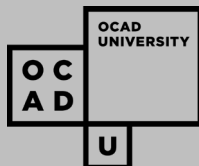
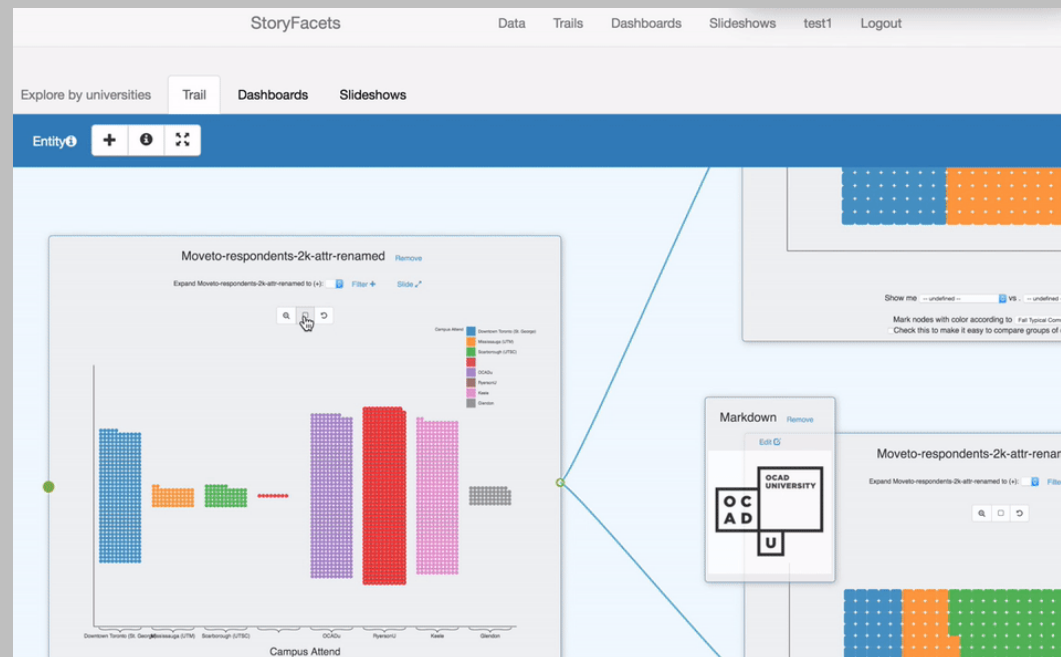
OCAD U Frequency Mode



Screen Shot Student MoveTO



StoryFacets Visualizations - Student MoveTO data



StoryFacets - Dashboard

StoryFacets Trails Dashboards Stories DZheng Logout

keAnalyze0420 Explore Dashboard Story

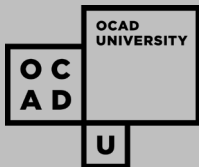
Dashboards

Type the new dashboard name

keAnalyze0420

Total number of dashboards: 1

Import existing explorations into Dashboard View



StoryFacets – Trail Markdown

StoryFacets

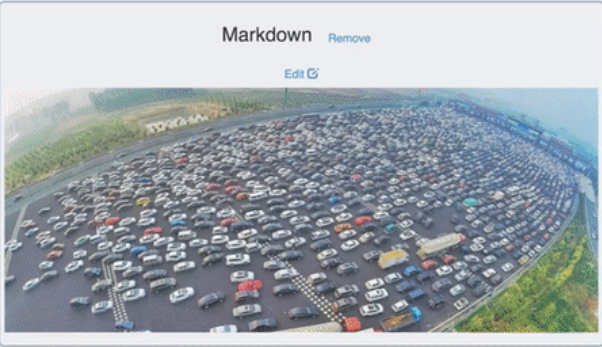
Data Trails Dashboards Slideshows test1 Logout

Qual data Trail Dashboards Slideshows

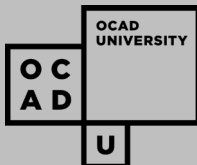
Entity + i ⌵ Public

Markdown [Remove](#)

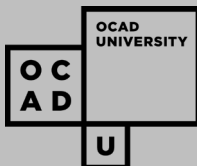
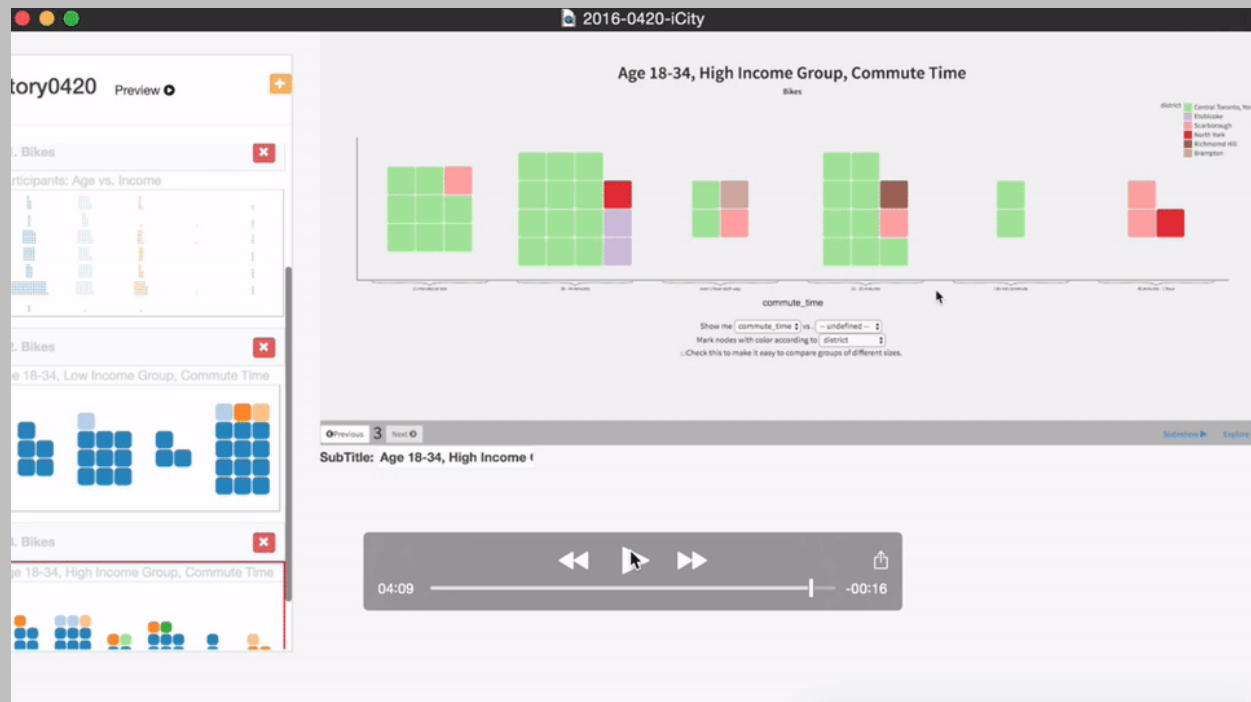
[Edit](#)



The screenshot shows the StoryFacets interface. At the top, there is a navigation bar with 'StoryFacets' and several menu items: 'Data', 'Trails', 'Dashboards', 'Slideshows', 'test1', and 'Logout'. Below this is a secondary navigation bar with 'Qual data', 'Trail', 'Dashboards', and 'Slideshows'. A blue header bar contains 'Entity' with a plus sign, an information icon, a expand/collapse icon, and a 'Public' status indicator. The main content area features a 'Markdown' block with a 'Remove' link and an 'Edit' link with an external link icon. The block contains an aerial photograph of a large, densely packed parking lot filled with many cars.

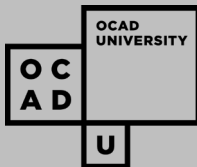


StoryFacets - Slideshow



StoryFacets – CSV File Import

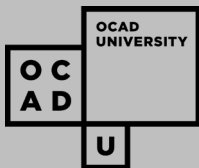
The screenshot displays the StoryFacets web application interface. At the top, the navigation bar includes the application name "StoryFacets" and several menu items: "Data", "Trails", "Dashboards", "Slideshows", "test1", and "Logout". The main content area is titled "Data" and features a section for uploading a CSV file. This section contains a large dashed rectangular box with the text "Drop files here or click to upload" centered inside. Below the upload area, there is a section labeled "Existing Entities" which contains a prominent blue button with the text "Manage Relationships". At the bottom of the interface, it states "Total number of entities: 0".



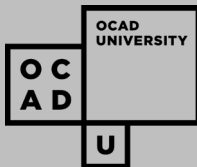
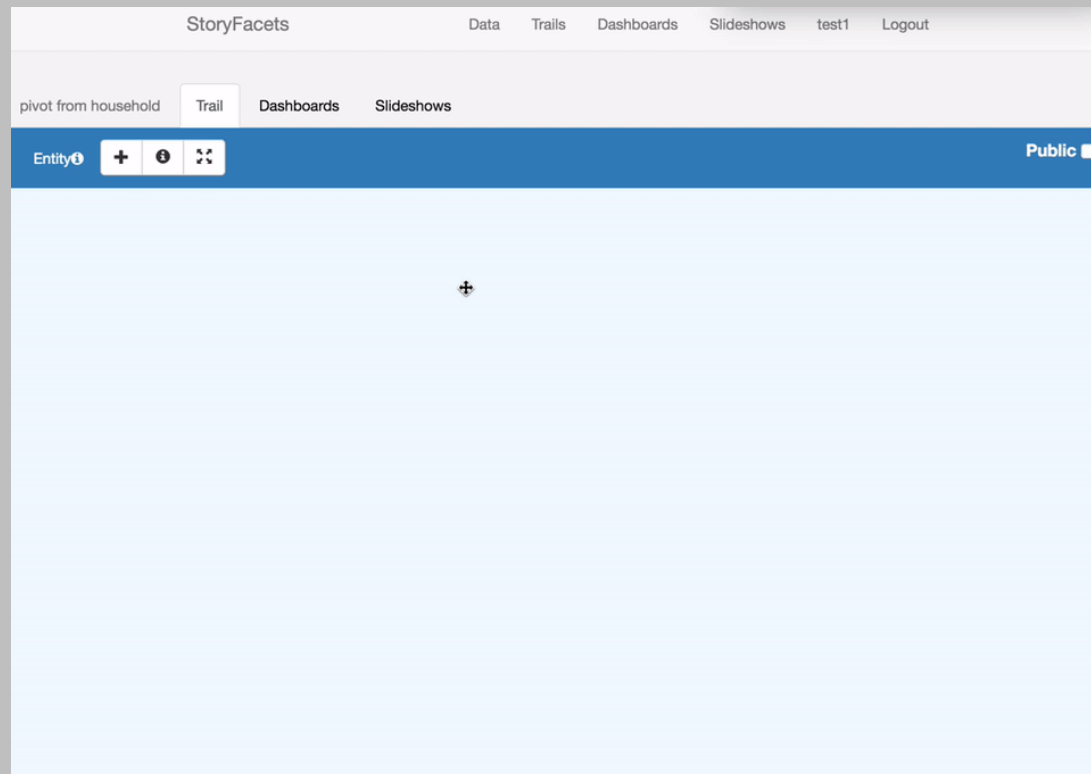
StoryFacets – Define Relationship

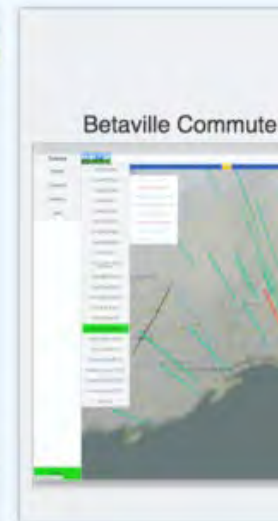
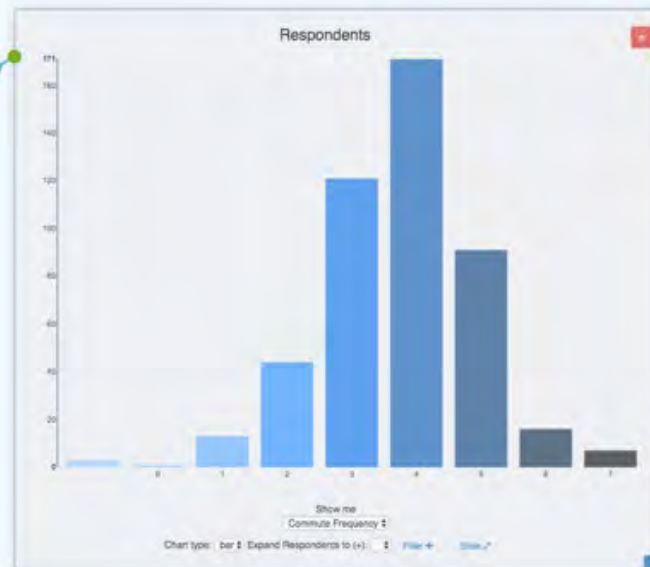
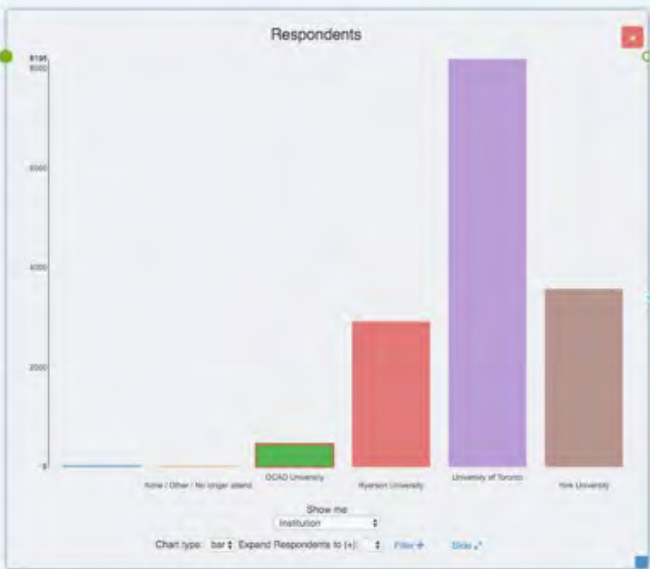
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Entity Name	Action
Respondents	
Rel-household-sm	
S...	



StoryFacets – Trail - Pivot





Software: StoryFacets and Betaville – IBM Mitacs ACCELERATE, ORF-E

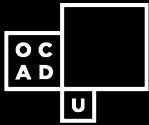
Data: StudentMove T.O.

Description: 2D Graphs generated in StoryFacets represented in a narrative sequence with 3D data from Betaville

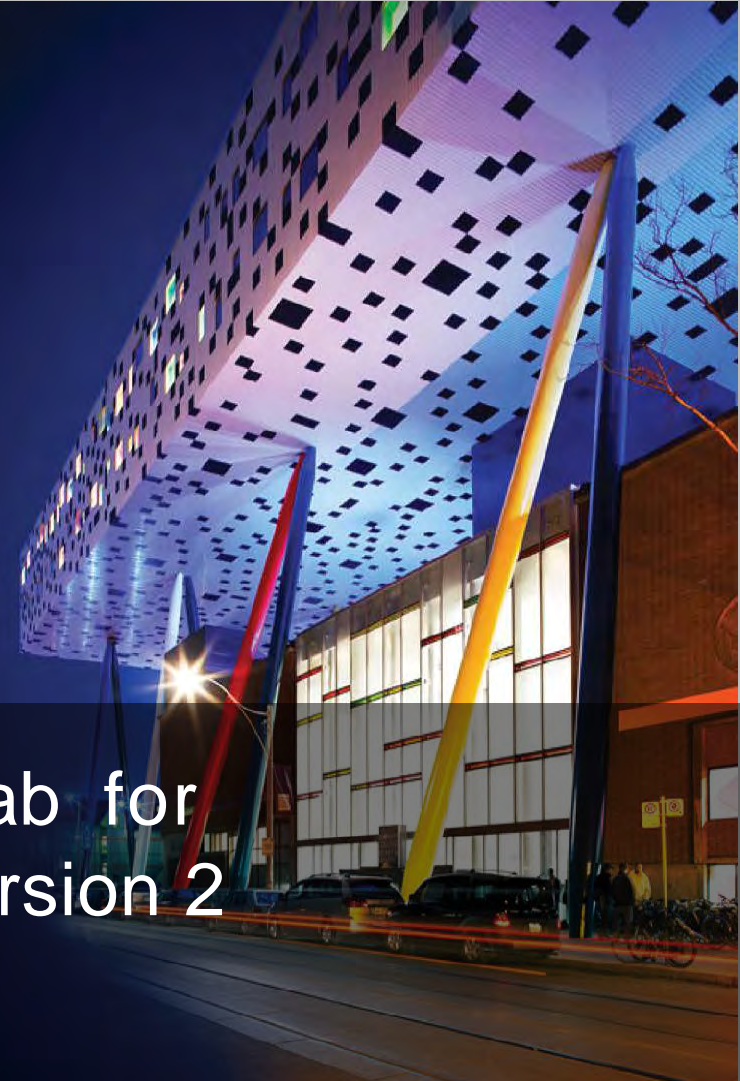
Professor Jeremy Bowes
Dr. Sara Diamond

OCAD University

The Visual Analytics Lab for StudentMOVE Version 2



© 2020 OCAD University.



Information Data Types

(based on survey)

Respondent Attributes & Information

- Age, gender, drivers license, transit pass, bike, available auto; type, fuel, model
- Hours worked per week
- University / college attended, faculty of study

Travel & trip data

- Typical mode of transportation, first mile / last mile
- Past month's transport behavior, preferences
- Multi – modal transport, sharing etc.
- Transportation safety: Cars, walking, bike, transit

Household Information

- Living situation and household type, roommates, children
- Available vehicles
- Type of home, rented or owned
- Household Income

Respondent Attitudes

- Commute: campus & course schedule choice, participation
- Travel Motivations: destination time, flexibility and predictability, multiple stops, climatic conditions
- Transportation safety: Cars, walking, bike, transit
- Travel satisfaction and subjective well being

Survey Information

PERSONAL ATTRIBUTES

- Gender
- Age
- Residency Status
- Disability
- INSTITUTION Affiliation
- University
- College
- Student Status
- Year of College
- Enrollment Year
- End Credential
- Work Off-campus

INSTITUTION

- Centennial College
- Durham College
- McMaster University
- Mohawk College
- OCAD University
- Ryerson University
- Seneca College
- Sheridan College
- UOIT
- University of Toronto
- York University

MOBILITY TOOL OWNERSHIP

- Driver's Licence
 - Personal Use Auto
 - Transit Pass
 - Bicycle
 - Bike Share Service
 - Rideshare App.
 - Car Sharing App.
 - Trip Planner
 - Monthly Costs
- Travel Diary**
- Trip reasons
 - Locations
 - Purpose
 - Specific Modes
- Last Month's Travel**
- Modes
 - Frequency
- Typical Commute Characteristics**
- | |
|---------------------------|
| Main means transport |
| Last km modes / distances |
| Satisfaction |
| Barriers to ideal mode |

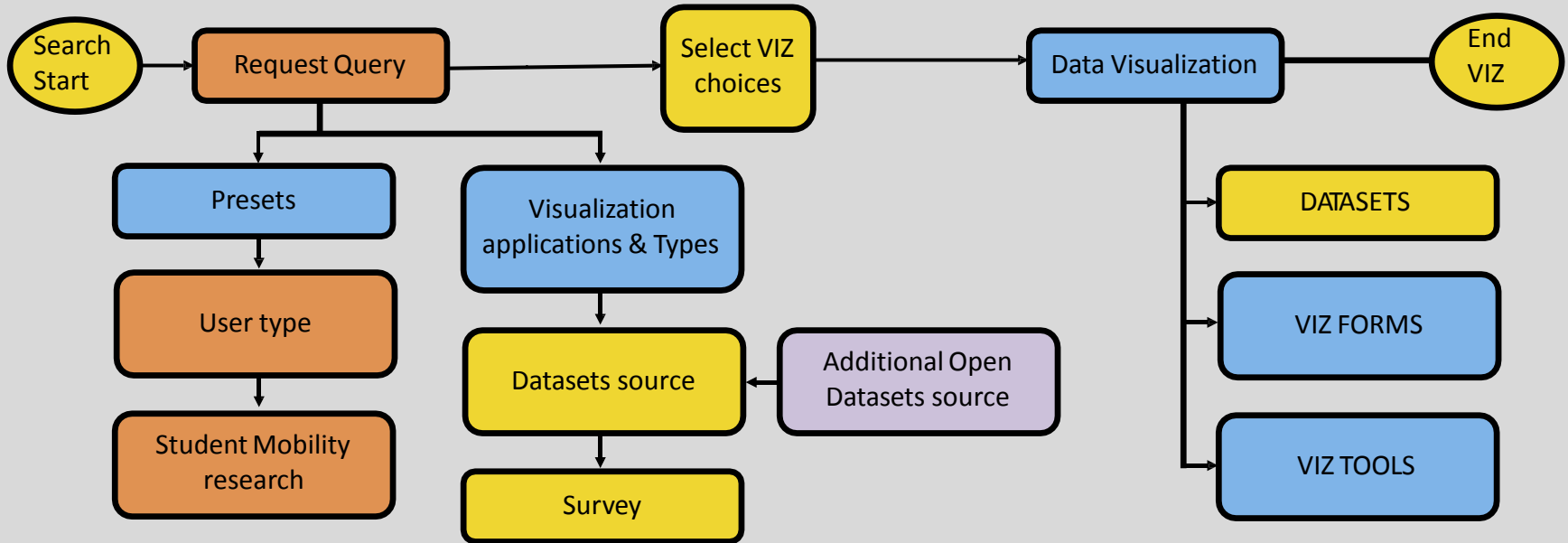
HOUSEHOLD ATTRIBUTES

- Living situation
- Household structure
- Vehicle in HH
- Type of Home
- Length of tenancy
- Own or rent
- Family support
- Gross family income

ATTITUDINAL QUESTIONS

Campus Life	Travel Motivations	Travel Satisfaction	Transport Safety	Subjective Wellbeing
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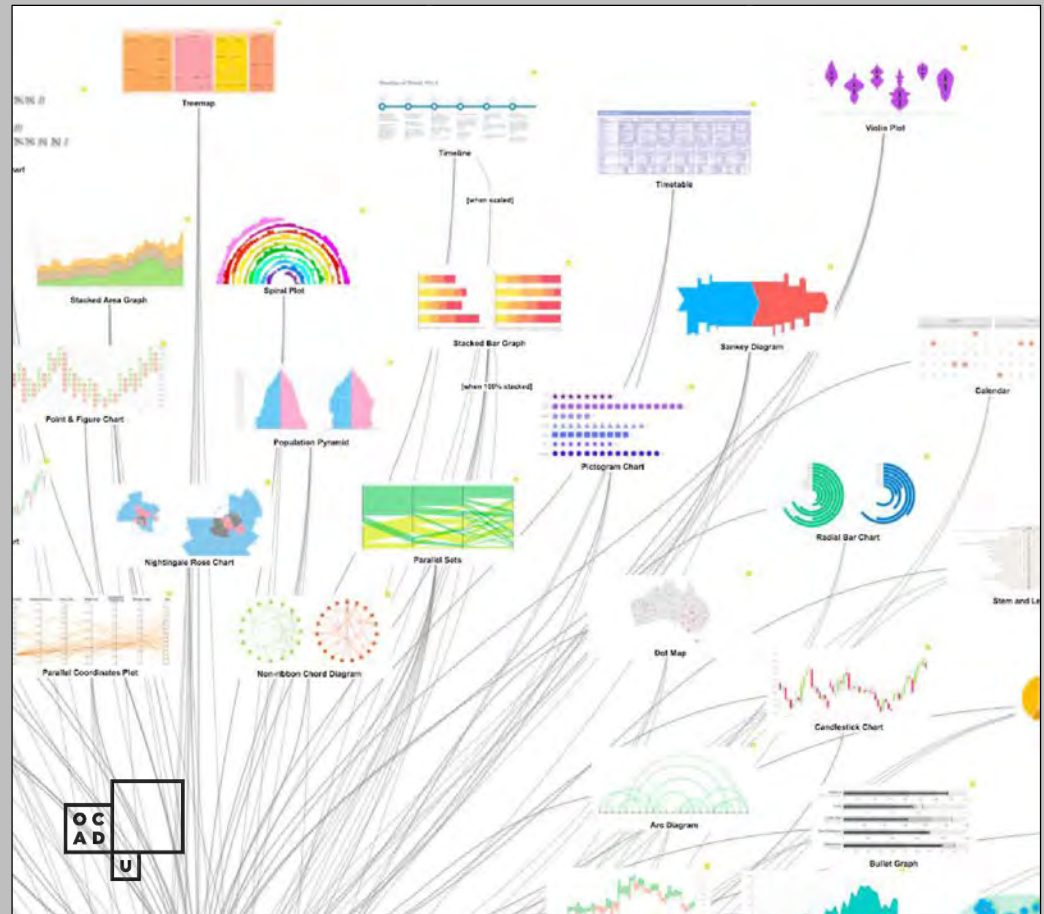
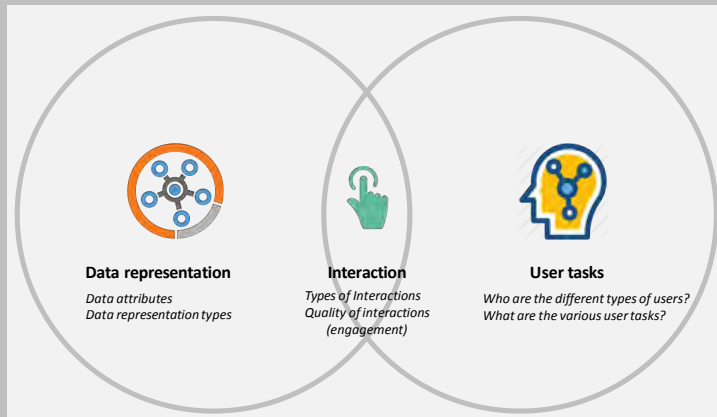
Visualization System Flowchart



Process:

Process

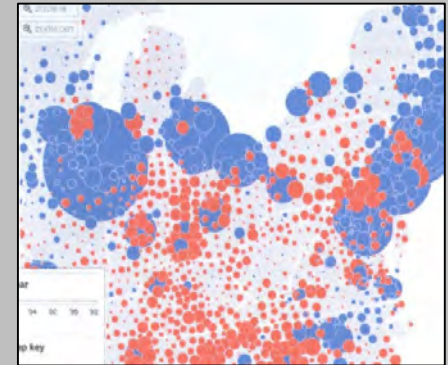
Designing visualization entails understanding the users tasks, (what researchers and users of the data want to determine), and integrating the required data representation with the necessary interaction. Sources of acceptable visualization types like the one here provide a catalogue of possible types.



Visualization: Typical Commute Characteristics

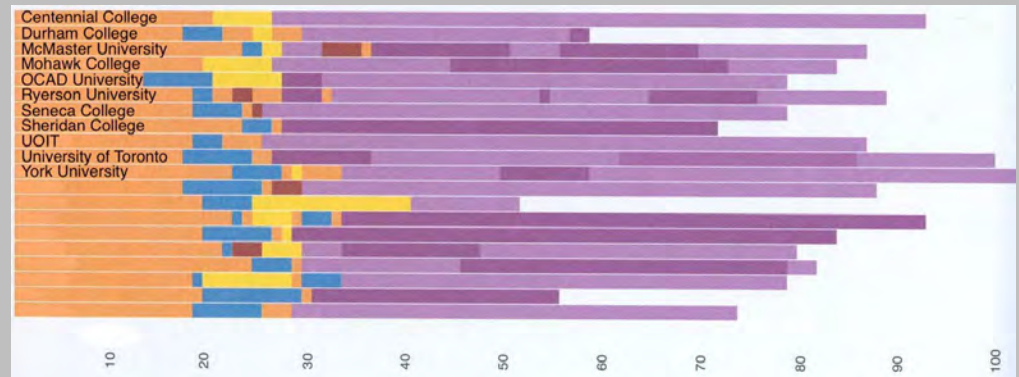
2D dot distribution maps

Example of local map to show institution locations, walkable last km zones, and respondents living within zones, using dot distribution, and choropleth maps
Program status, full part time etc. can be highlighted by dot colour, and clustering



Bar graphs with annotated components

To show commuters by institution, distribution of respondents by part time, full time, continuing etc. can be highlighted

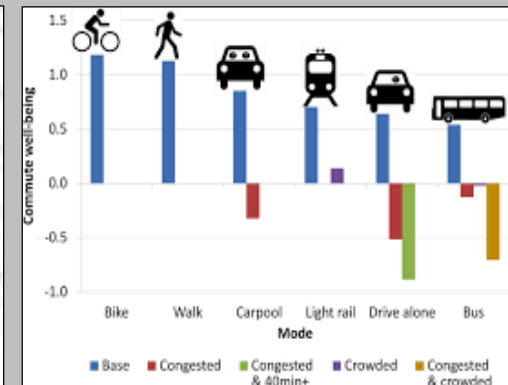
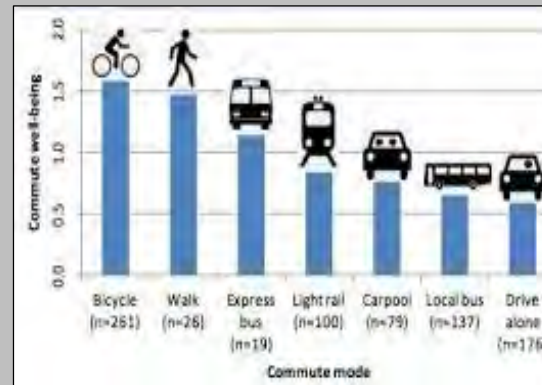


StudentMOVETO: Visualizing institutional numbers at colleges and universities.

Visualization: Typical Commute Characteristics

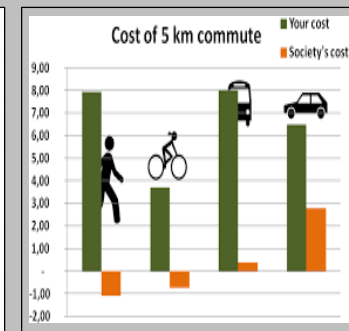
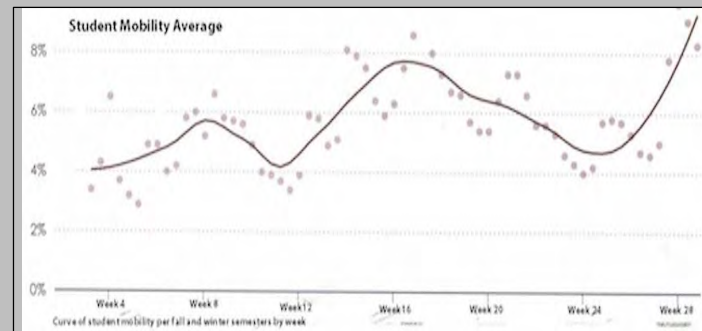
Bar graphs with annotated components

To show commuters modes overall, or by institution. Can be broken down by part trips (last km) or main modes, lone drivers or shared driving. Cost by mode, compared to cost generated by mode, GHG average data, could also be highlighted as below.



Curve with annotated components

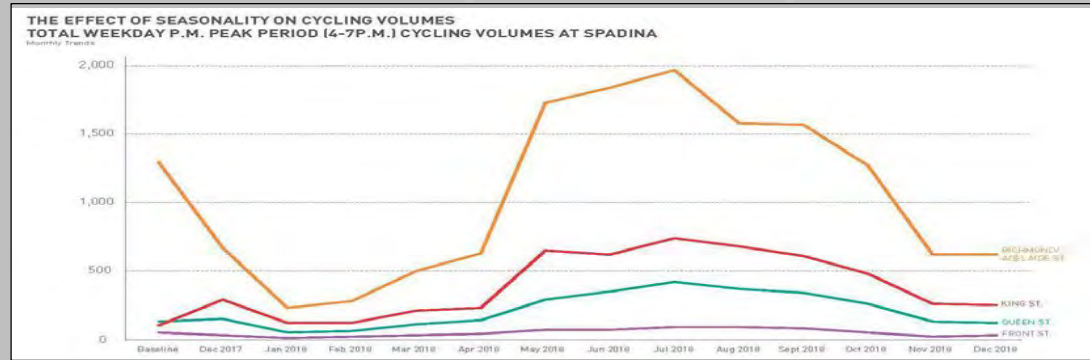
To show student mobility average, either overall, or by season and/or by institution with plotted scatterplots and methods of averaging to generate characteristic pattern. (Loews curve)



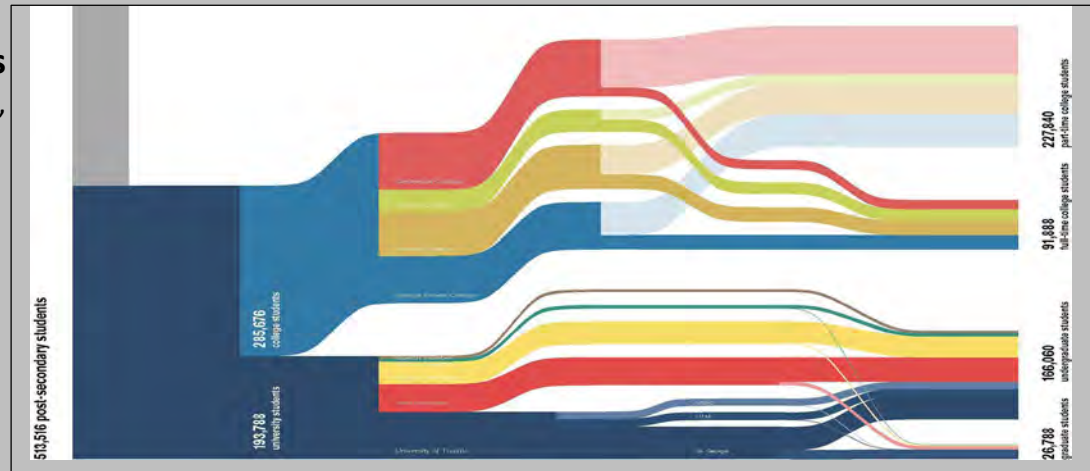
StudentMOVETO: Visualizing institutional numbers at colleges and universities.

Visualization: Typical Commute Characteristics

Curve with annotated components
To show student mobility, bike, shared service, walking etc.) for last trip average, both home to transit or institution to transit to generate characteristic pattern.



Sankey diagram with annotated components
To show student respondents by institution, program, and campus location.



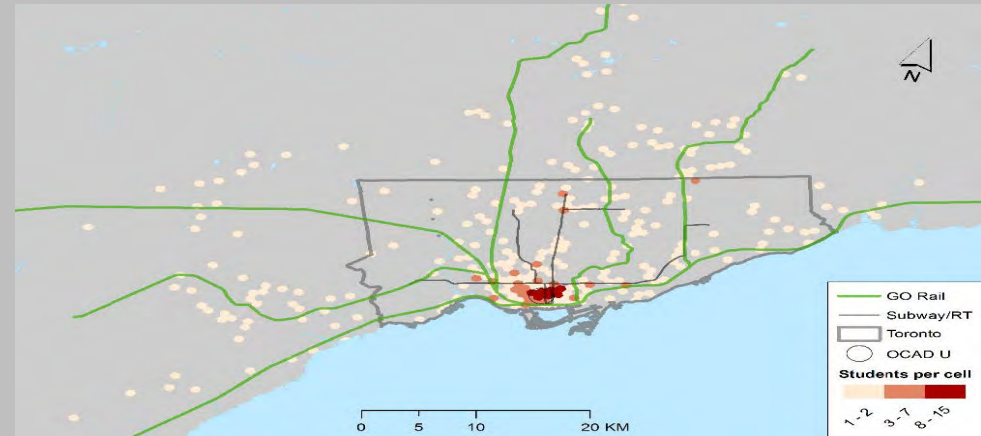
StudentMOVETO: Visualizing institutional numbers at colleges and universities. Sankey diagram (studentDWELL, Ultan Byrne)

Visualization: Household attributes



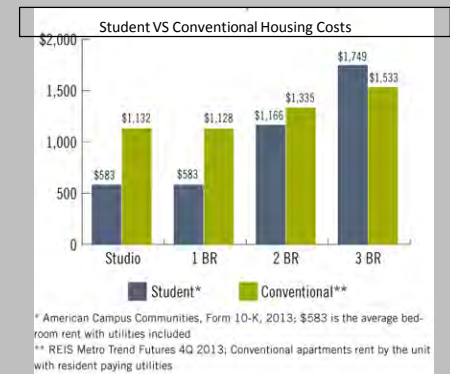
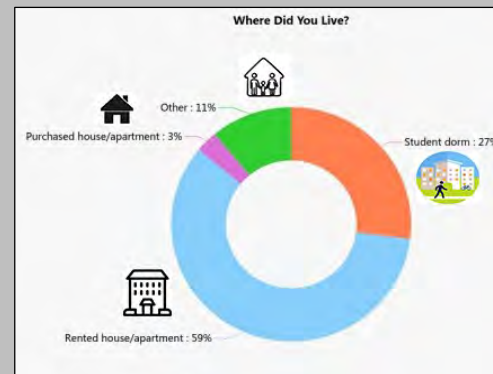
2D dot distribution maps

Example of local map to show institution specific locations, and respondents living locations, using dot distribution. (could be expanded to choropleth maps) This can be coupled with distances travelled, and correlated with aspects of student involvement and well-being. Source: StudentMOVETO 1.0,



Circular diagrams

To show student housing accommodations by type choice. Could be expanded to add choice of household structure, and coupled with bar charts showing student housing costs relative to conventional housing costs.

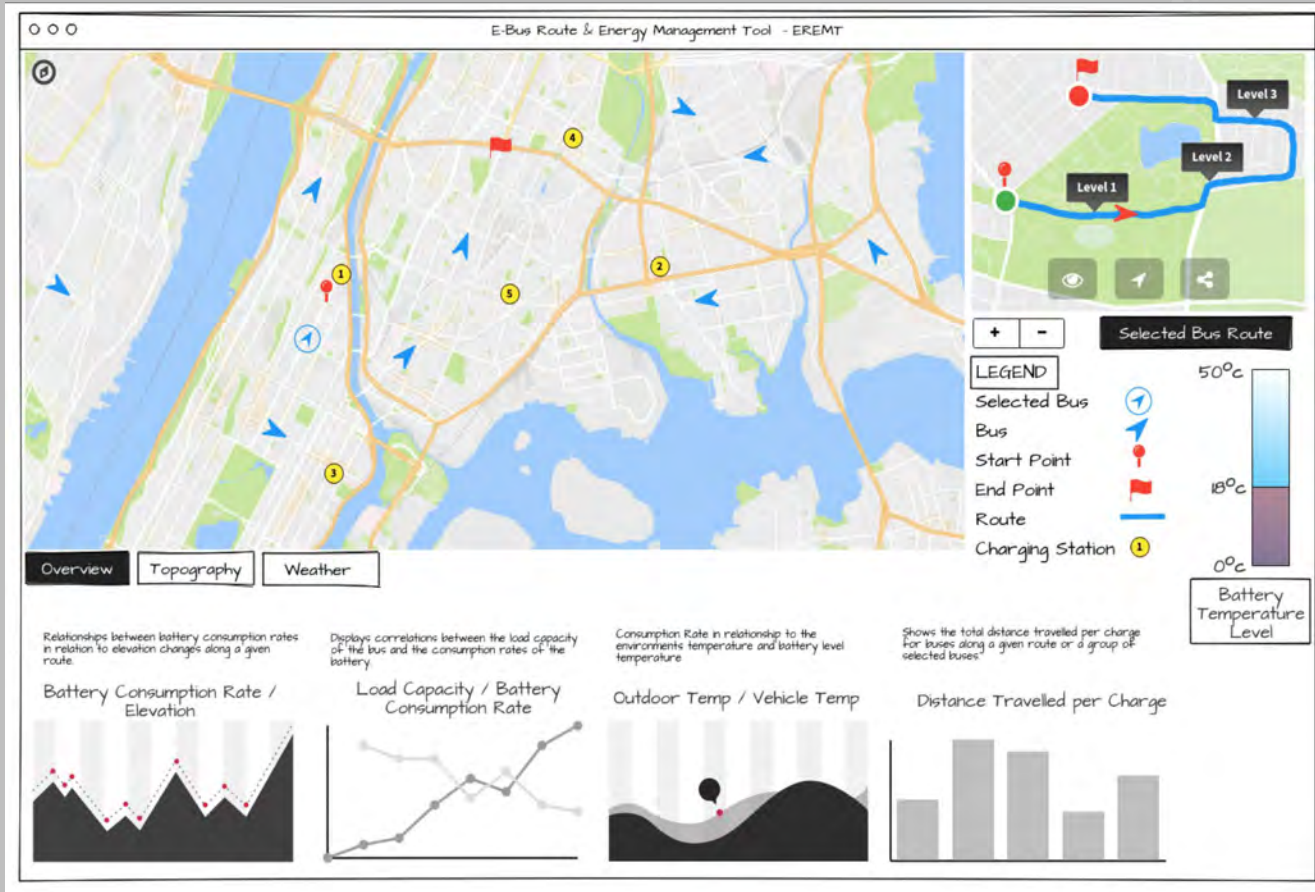


StudentMOVETO: Visualizing institutional numbers at colleges and universities, top map, <https://www.utoronto.ca/news/studentmoveto>, (Matti Siemiatycki (graphics by Geoff Agnew))

Interaction and Dashboards

StudentMOVETO: Visualizing institutional numbers at colleges and universities.

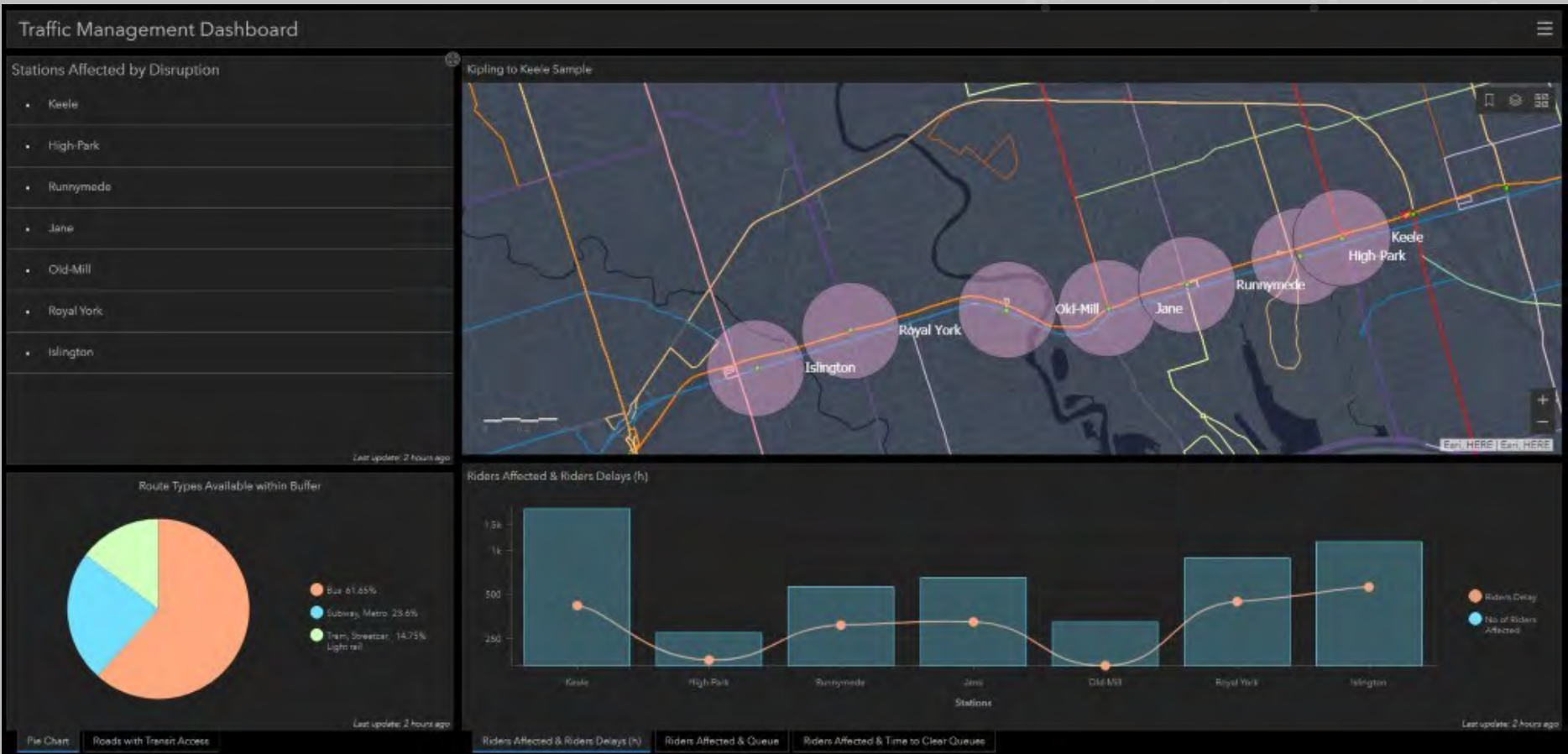
Dashboard work



Design and Prototyping of 2D and 3D visualizations integrated with maps

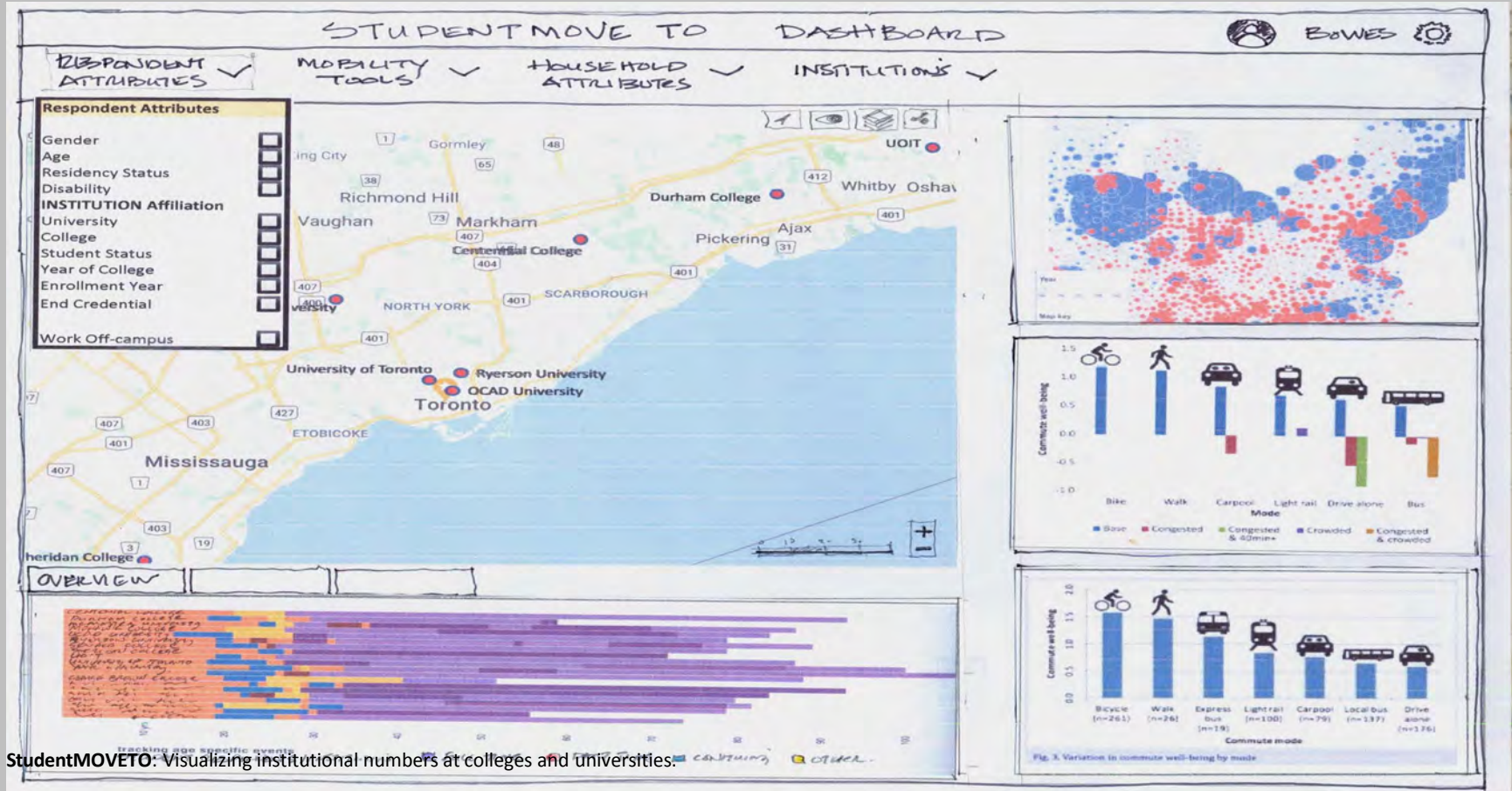
Example of a first sketch prototype of a user-centered dashboard to support implementation of electrical buses in Canada, VAL team, Olufunbi Disu-Sule.

Dashboard work

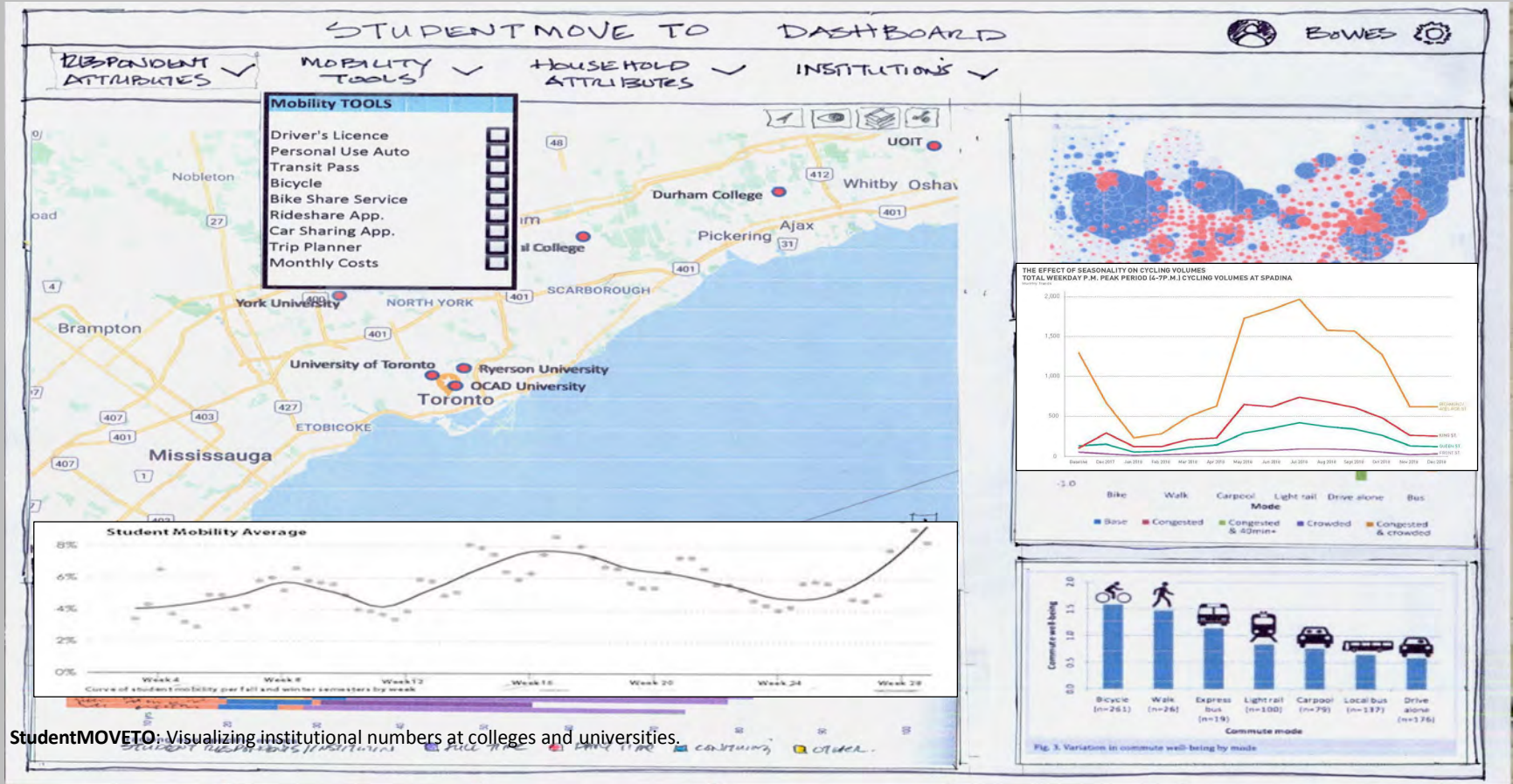


ICITY Project: Visualizing urban transportation, VAL team, Olufunbi Disu-Sule.

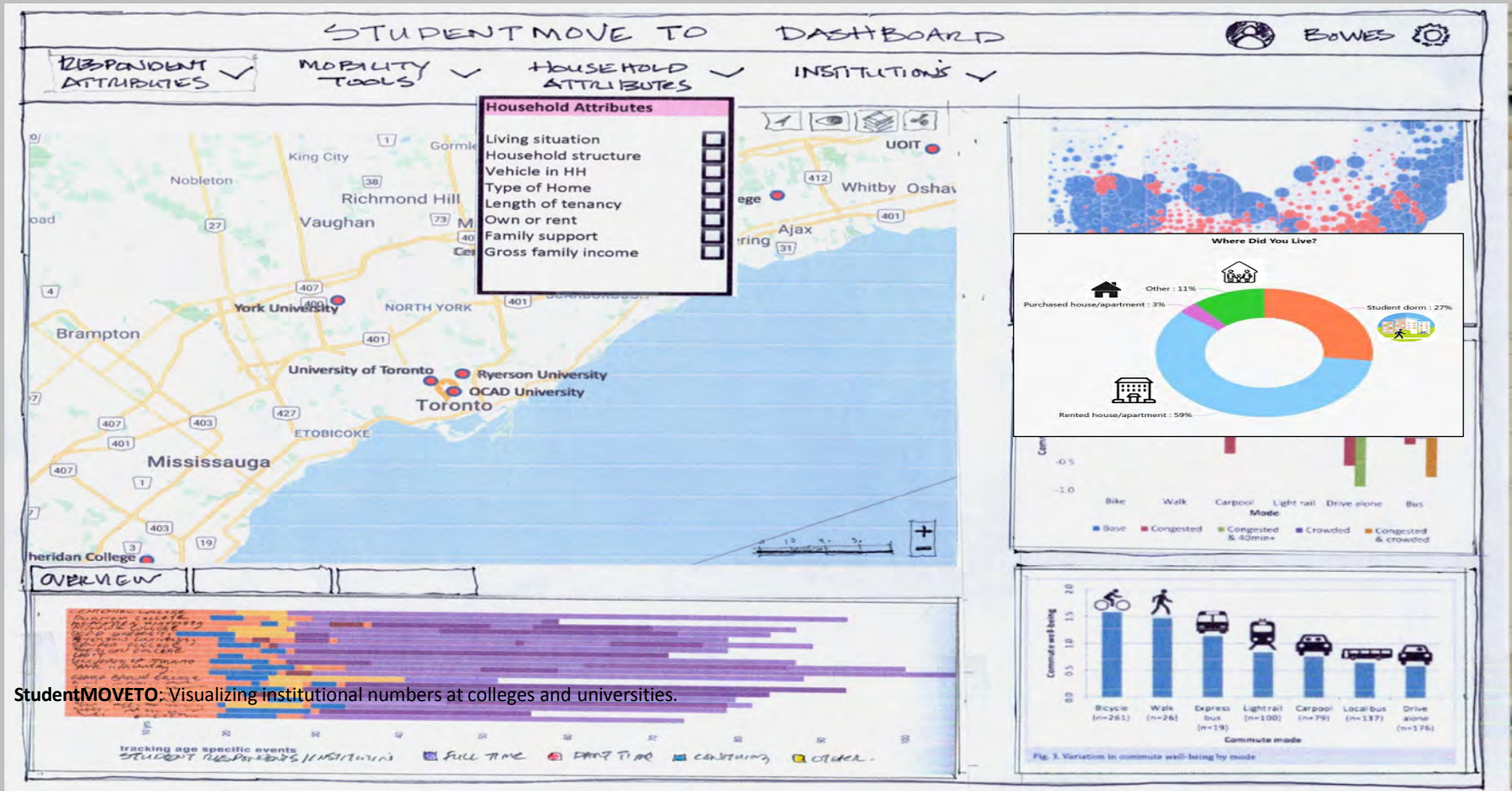
Dashboard prototype work



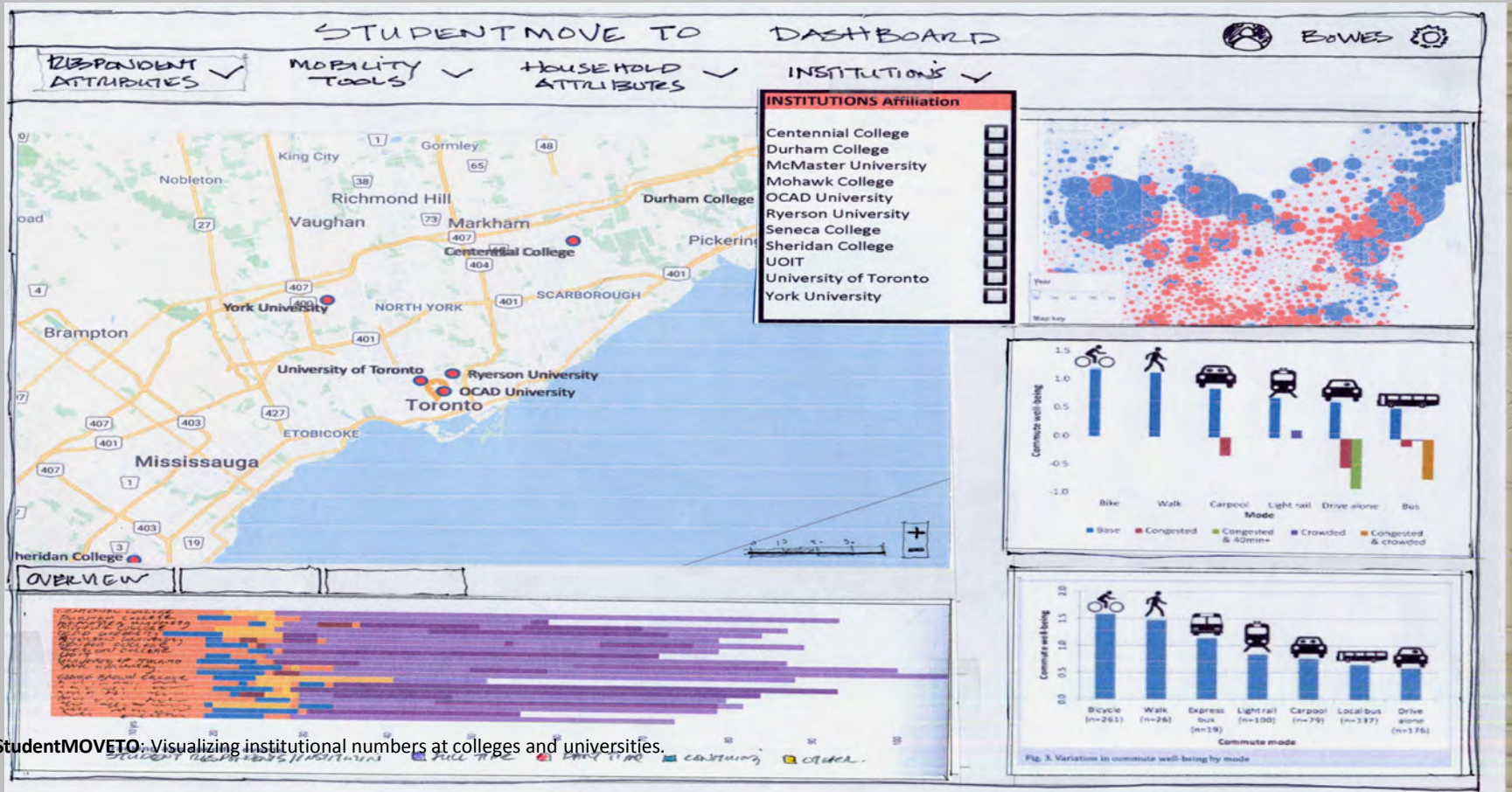
Dashboard prototype work



Dashboard prototype work

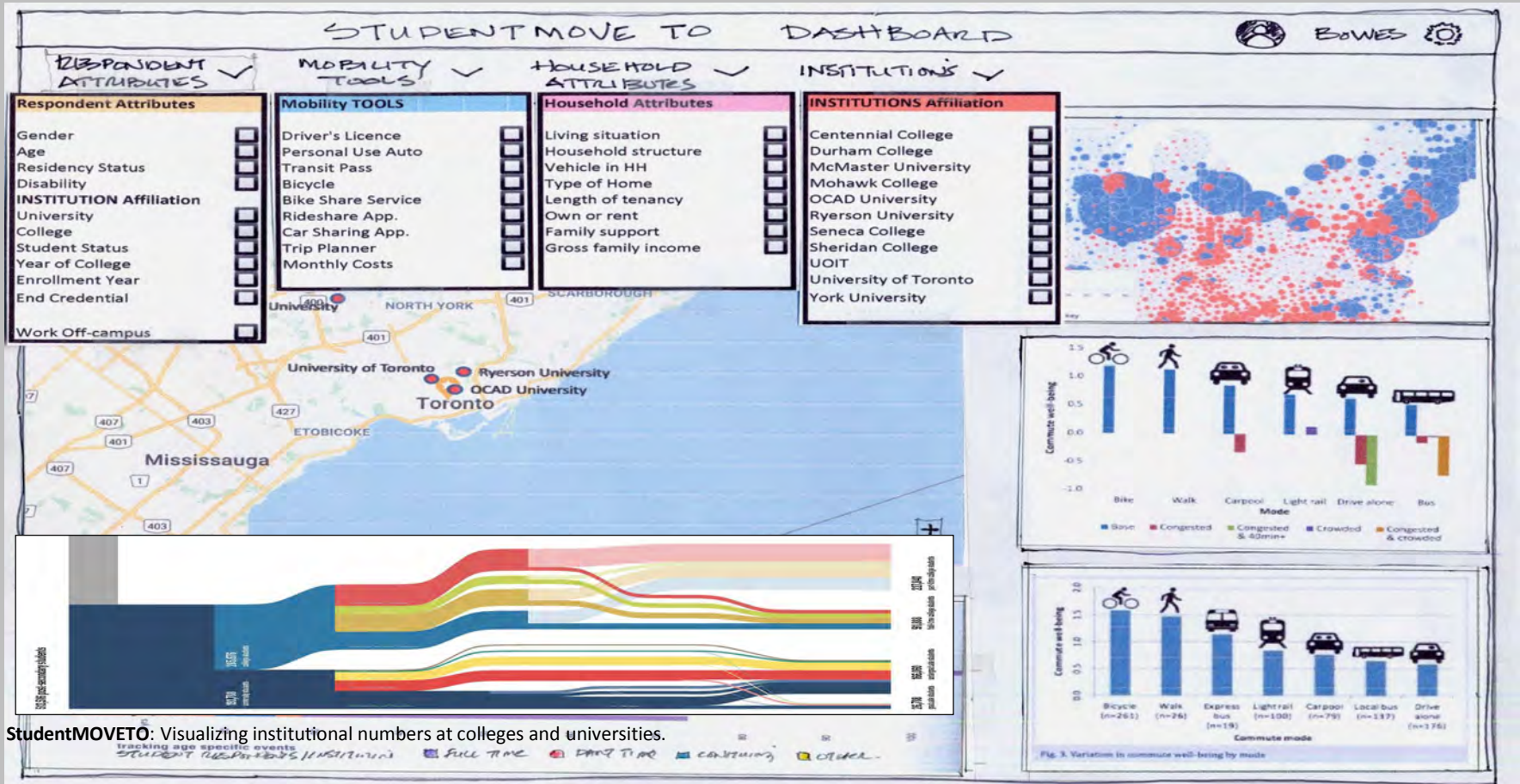


Dashboard prototype work



StudentMOVE TO: Visualizing institutional numbers at colleges and universities.

Dashboard prototype work



StudentMOVETO: Visualizing institutional numbers at colleges and universities.

Next steps: Program of participation

What types of information needs to be visualized, and what filters would be helpful in queries?

- Continue to work to obtain feedback from researchers on search parameters / variables, (Use case sheets from researchers)
- Determine the level of dashboard interactivity
- Identify groups of information that are searchable
- Prepare prototypes for review

A detailed street map of a city, likely New York City, showing a dense network of streets. A prominent red grid is overlaid on the map, highlighting a specific set of streets. The text "Thank You" is centered over the map in a large, black, sans-serif font.

Thank You