

Using Big Data Visualization to Create Smarter Cities

Dr. Sara Diamond, OCAD University

What is a smart city?

- Smart city initiatives are broad reaching enablers to civic aims; the point is not the technology, but the outcomes the technology can deliver – resident engagement, connectivity, collaboration, innovation, resiliency, livability, equity.
- Socio-economic + Technology + Expectations
- Energy and carbon consumption
- Transportation and movement – human and autonomous
- Development and planning

Data Rich, Data Producing

- An invisible grid made up of networks, packets and data (car GPS, GPS, GIS)
- Security and surveillance technologies, interactions (Cameras)
- Data producing, connected devices and analyzing sensors and devices (RFID, Sensors)
- Mobile internet, applications and devices (WiFi antenna, etc.)
- Open data
- Government records, corporate records (Census data, real estate tax value)

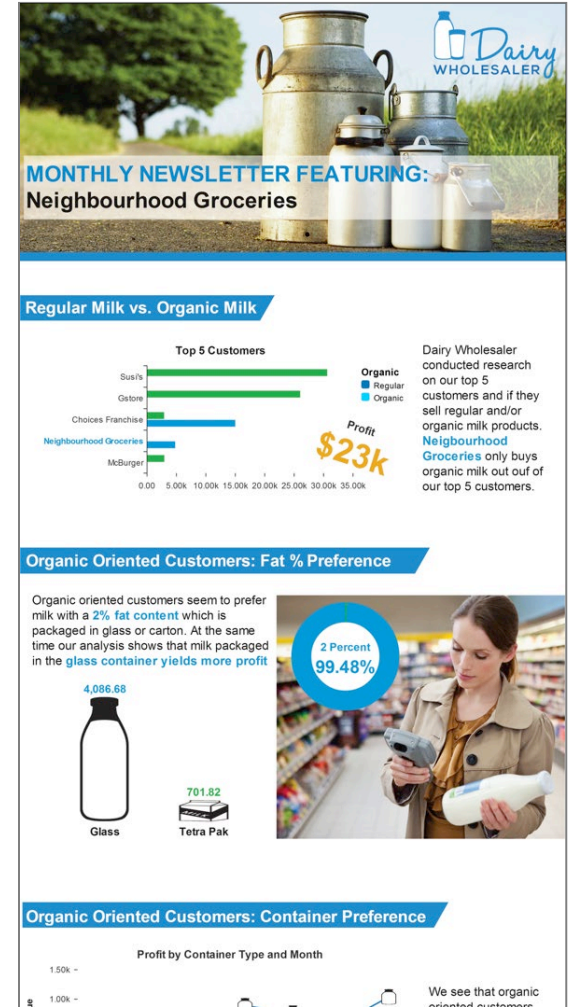
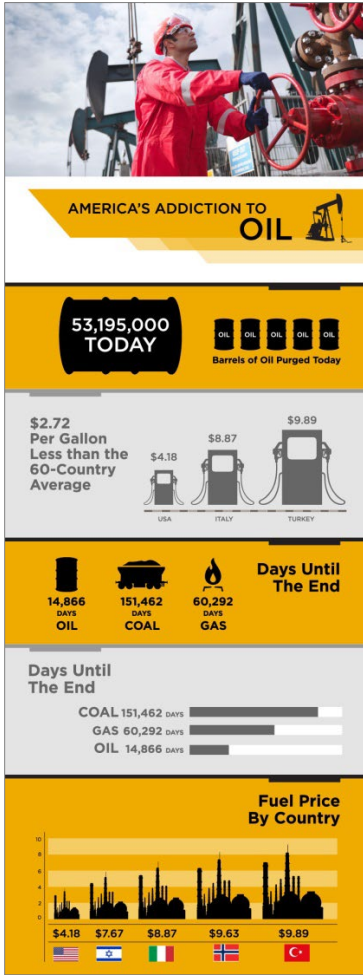
Business Analytics Systems

Lumira for Desktop



- Access and transform data, big and small, from multiple sources
- Explore and analyze data with HTML5 visualizations
- Tell data stories with visualizations and storyboards
- Easily share and consume visualizations

SAP Lumira Infographics



What's so special about SAP Predictive Analytics?

Advanced Visualization

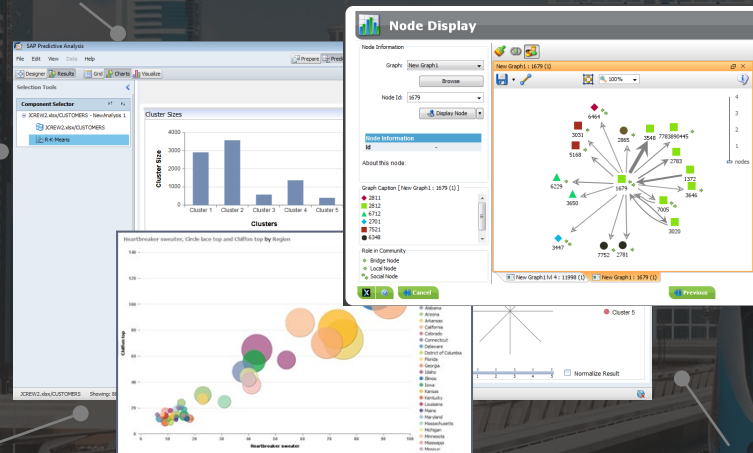
- Direct access to Advanced Visualizations
- Superset solution includes SAP Visual Intelligence library
- Stunning visualizations

Ease of Use

- Drag & drop data selection, preparation, processing
- Easy sharing /collaboration of findings
- Built for business analysts

Rich Pre-Built Modelling Functionality

- Automatic Data Preparation
- Classification
- Regression
- Anomaly Detection
- Attribute Importance
- Association Rules
- Clustering
- Feature extraction



Multi Language Support

- English
- German
- Spanish
- Portuguese
- French
- Japanese
- Italian

R Data Mining Language Support

- Native installer included
- ~12 R algorithms included
- 3,500+ R Model library and growing
- Custom R, JAVA, etc.

Integration

- Native integration with SAP HANA
- Leverage existing BOBJ universes
- Publish actionable results to mobile & BI clients

Predictive Use Cases

PUBLIC --- **SECTOR**

**Tax Fraud
Identification**

**Strategic Project
Planning**

**Predictive
Maintenance**

**Fraud, Waste, and
Abuse Discovery**

**Crime & At-risk
Prediction Analysis**

**Federal Grants &
Stimulus Modeling**

**Population &
Commerce
Planning/Zoning**

**Provincial & Local
Procurement Planning**

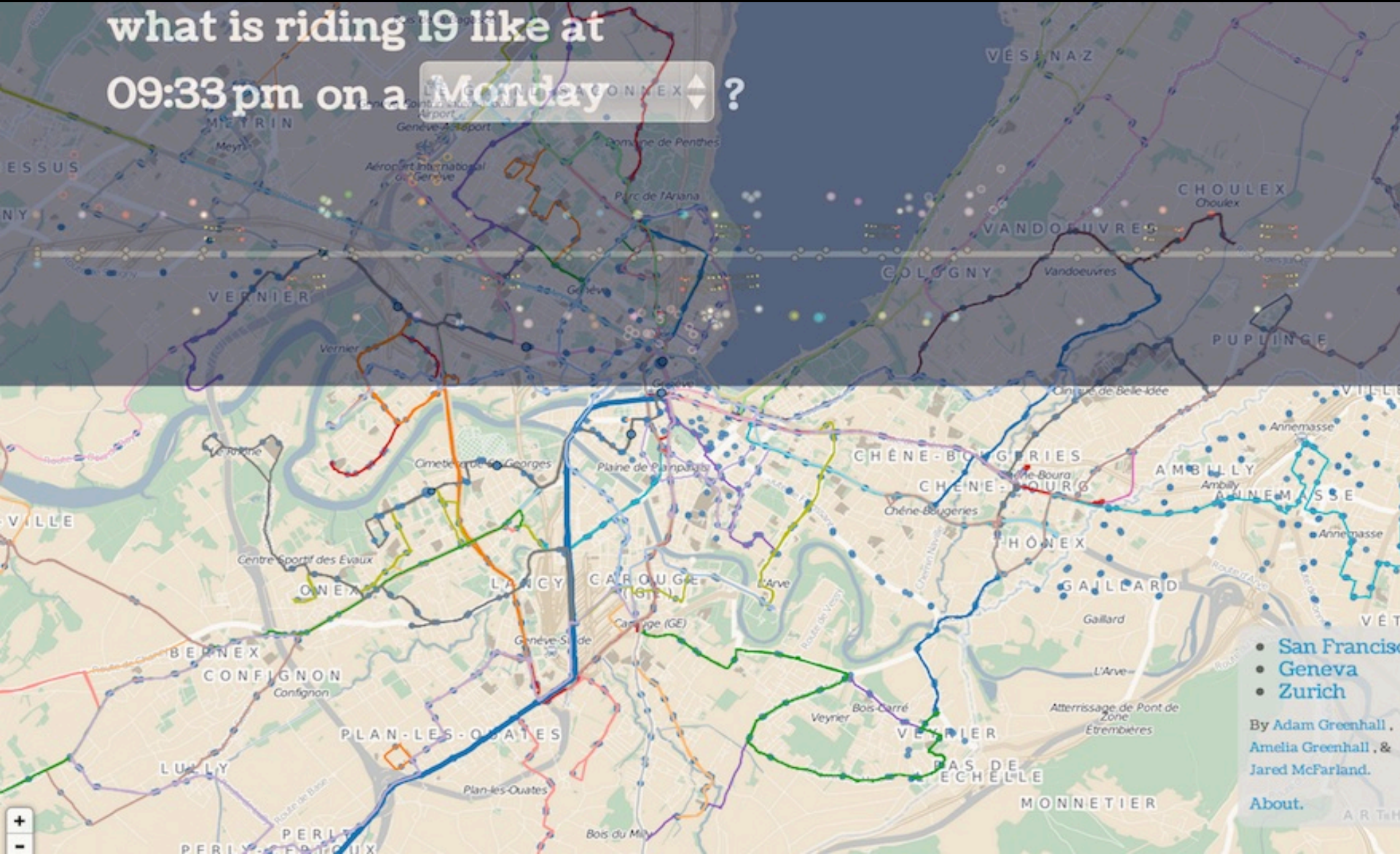
**Predict Community
Taxation**

Urban Prototyping Movement

- Urban Data Challenge
- Open data “hackathon”
- Merge and compare mobility data sets from three cities—San Francisco, Geneva, and Zurich—and draw meaningful insights.

Dots on the Bus, Adam Greenhall, Amelia Greenhall, Jared McFarland

what is riding 19 like at
09:33 pm on a Monday ?



- San Francisco
- Geneva
- Zurich

By Adam Greenhall, Amelia Greenhall, & Jared McFarland.

About.

A R T H

Transit Quality and Equity, Raymon Sutedjo-The, Sandra Lee



San Francisco

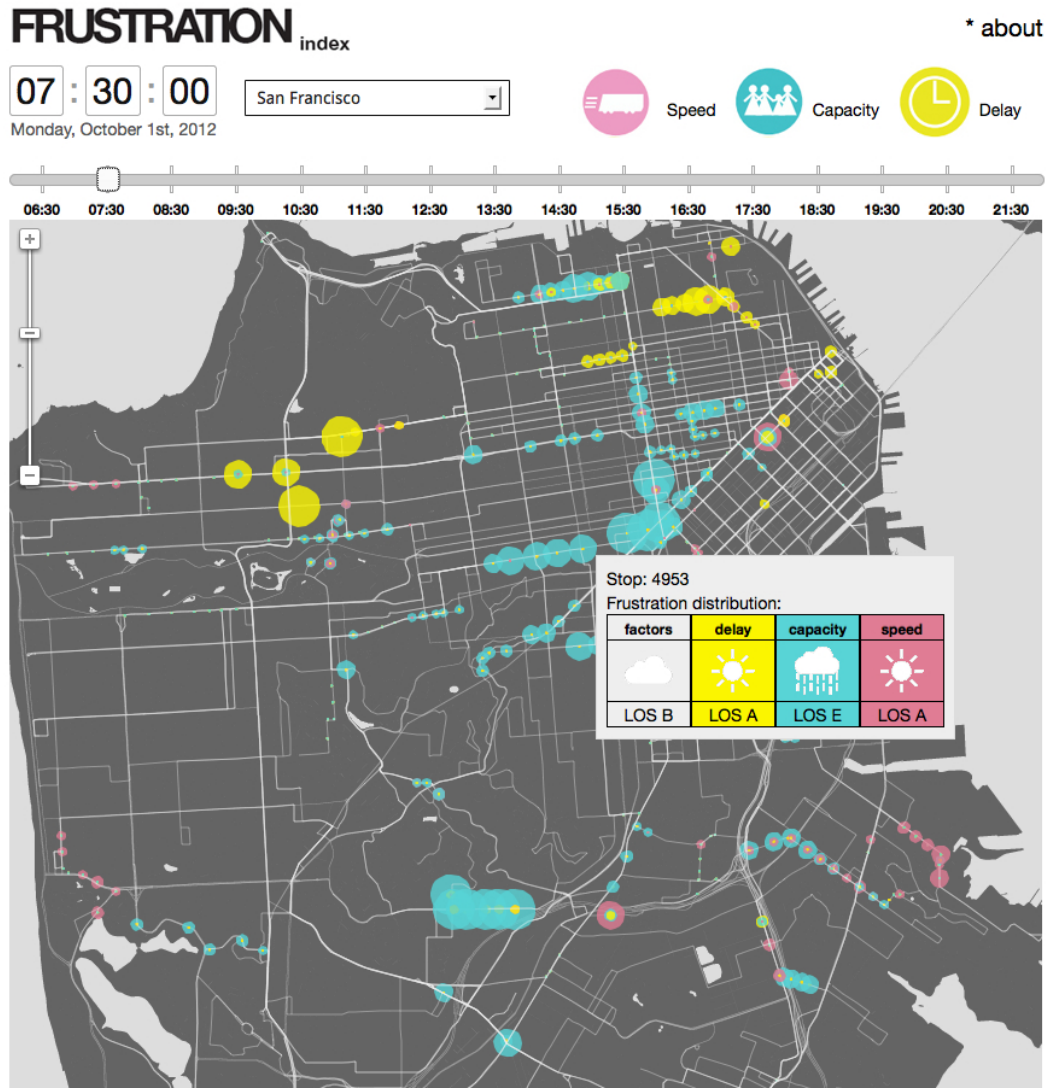
Economic Data

POVERTY LEVEL

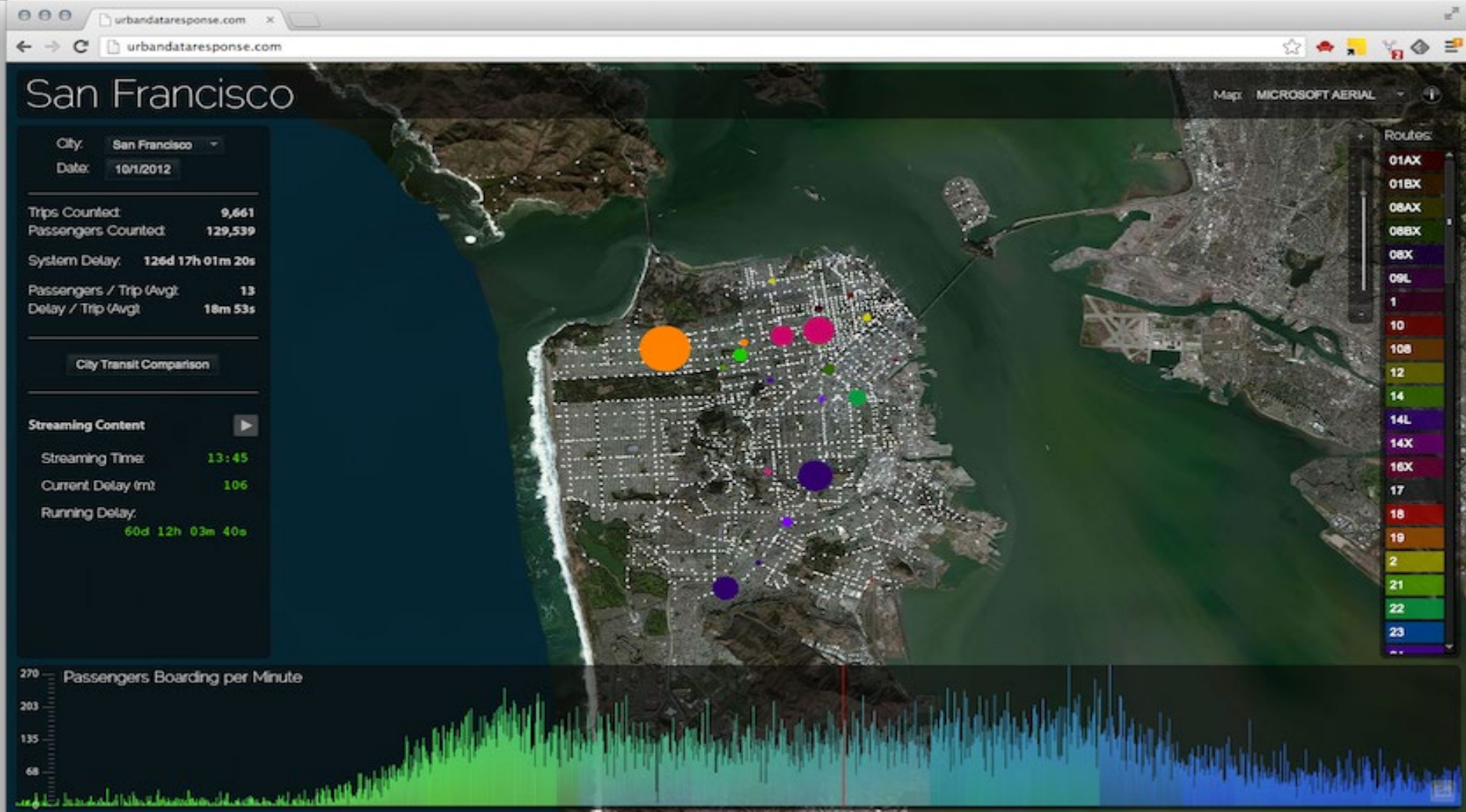
Routes

1	1X - 31X - 38X	2 - 3 - 4
5	6	8X
12	16X	19
28	14	14X/L
17	18	21
22	23	24
27	28	29
30	30X	31
33	35	36
37	38	39
41	43	44

Frustration Index, Srivinas Ashok, Daphne Dethier, Carmel Dudley, Steve Pepple



Urban Data Response, Matt Hill



Data Canvas – Media Network to promote public awareness

- DIY sensor network to measure pollution, dust, light, sound, temperature, and humidity. Overall environmental quality but also relevant to transportation uses.
- Created an interactive map, opened the data, and asked participants to use it to narrate a story about their city.

SELECT A CITY

- Temperature (C) 0.
- Light (Lux) 0.
- Pollution (mV) 0.
- Humidity (%) 0.
- Dust (pcs/238mL) 0.
- Noise (mV) 0.
- Speech

Info

sonic particles 2.0

A sonification of real-time urban environmental data

Sonic Particles

- <http://datacanvas.org/project/sonic-particles-2-0/>
- Sonic Particles 2.0 is a real-time sonification
Updated every 5 seconds.
- Each city can be differentiated.

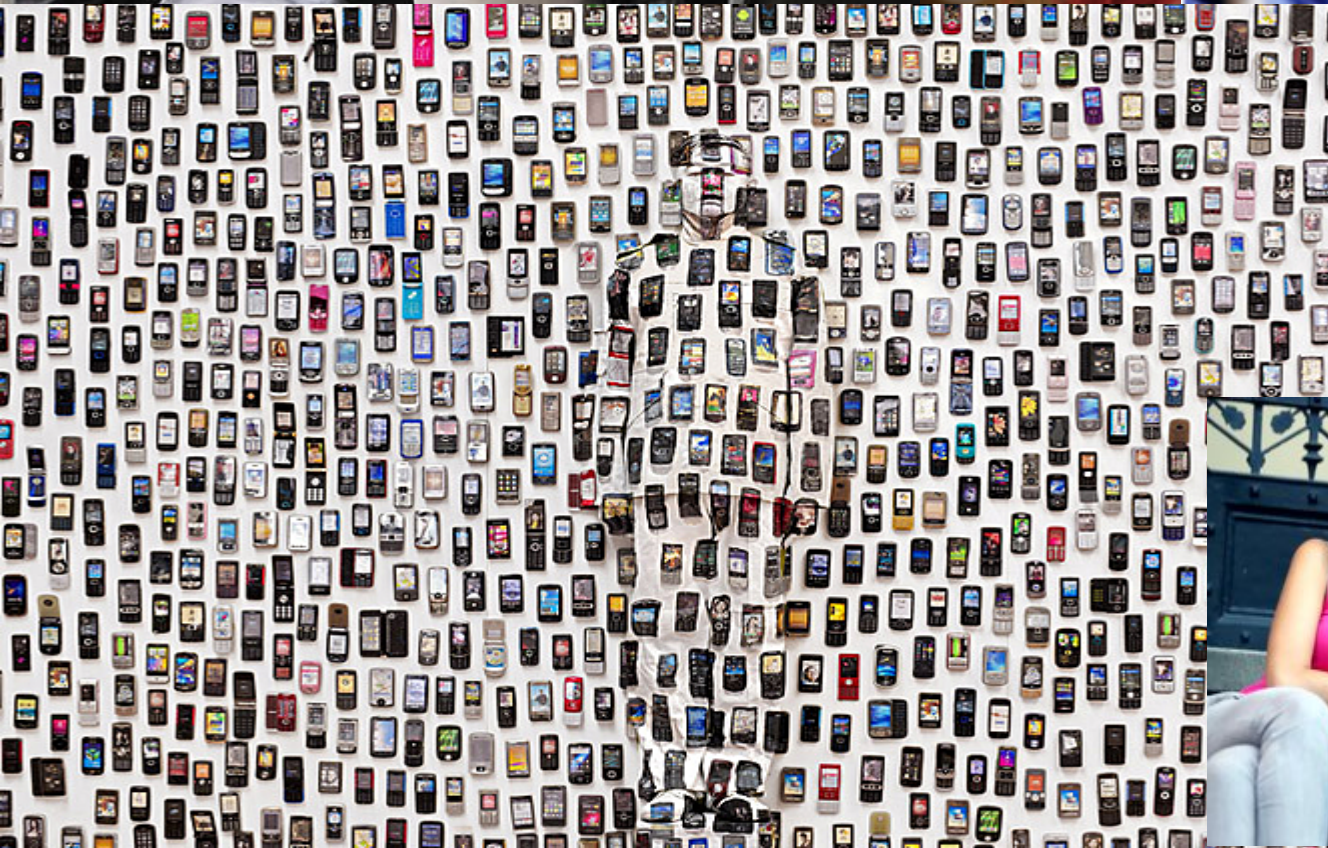
City as a Wealth of Data

- <http://flowingcity.com/>: Visualizing the City built of data, Urban Data Visualizations of the City, making the city smarter with data



gty.im/
142922431

By



Liu Bolin,
Hiding in the
City





The Mobile City: A Fully Enabled Grid

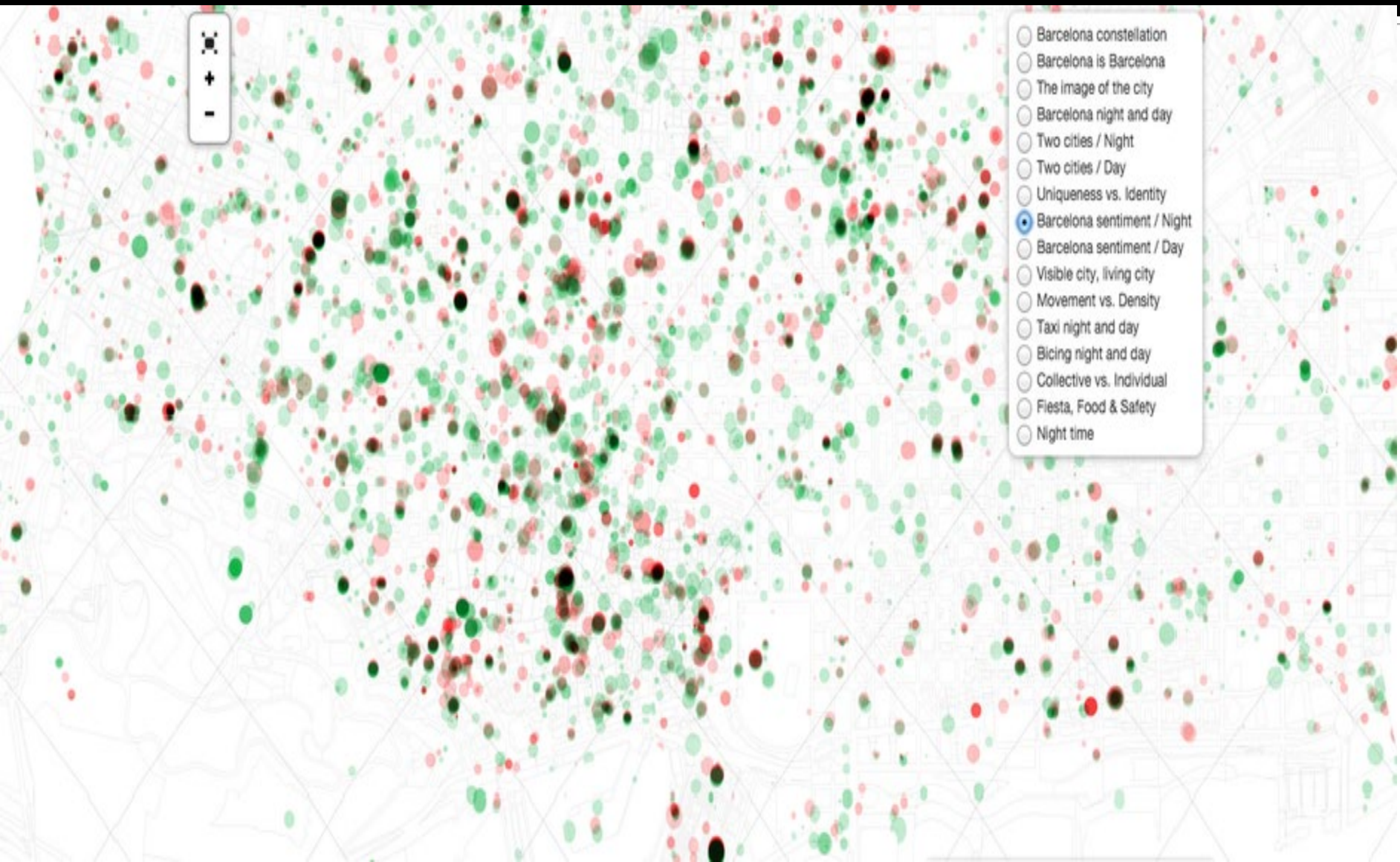
- Mobility is about the individual, not the device.
- The urban experience of ubiquitous connectivity, personalized and context-aware services and content that link us to daily activities and interests, regardless of time and place.
- Continual discovery, enhancement

Designing the City at Night, Barcelona (social media, open data, light), I -Varis, Diez & Corbero

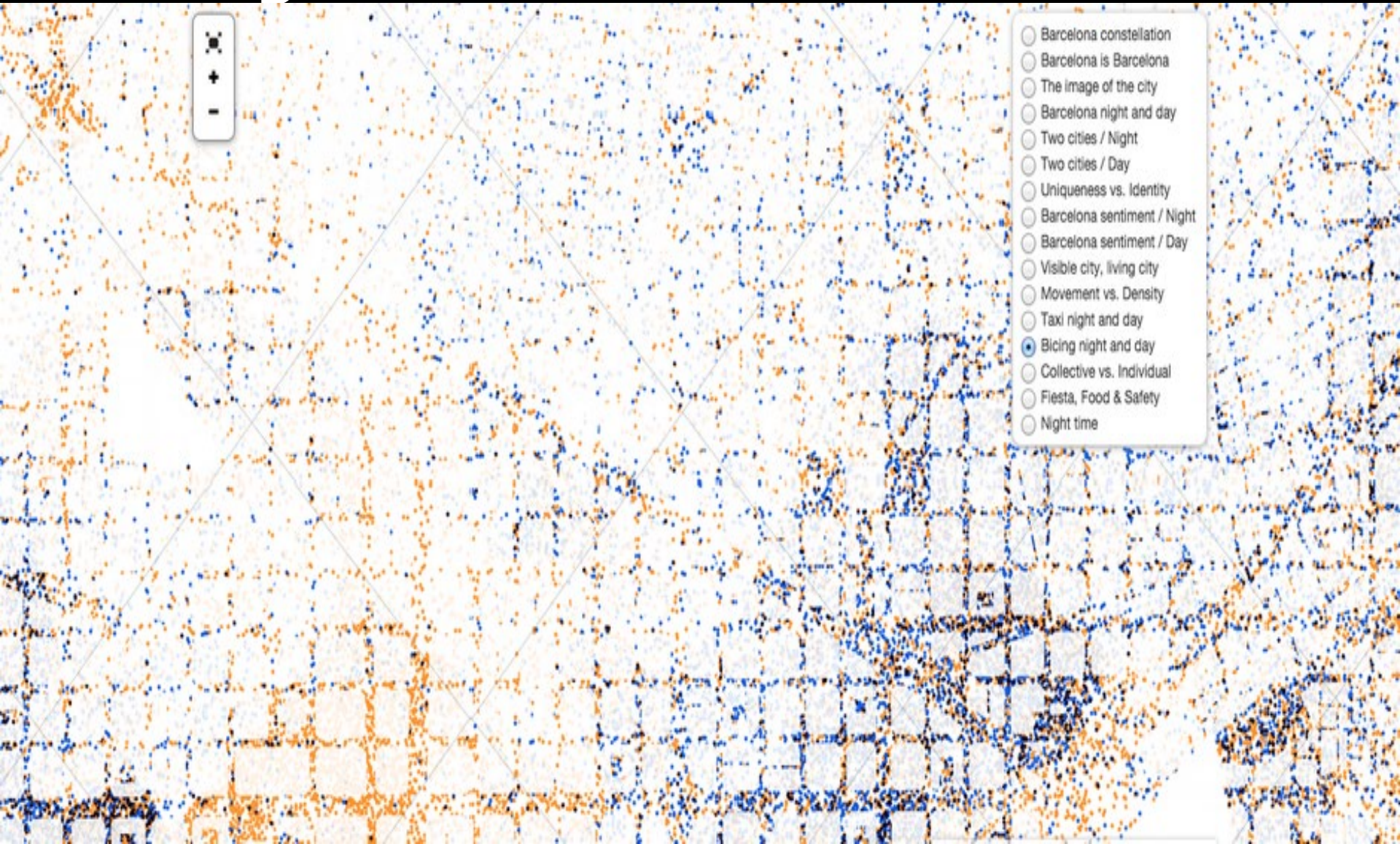


Designing the City, Tone of Social Media

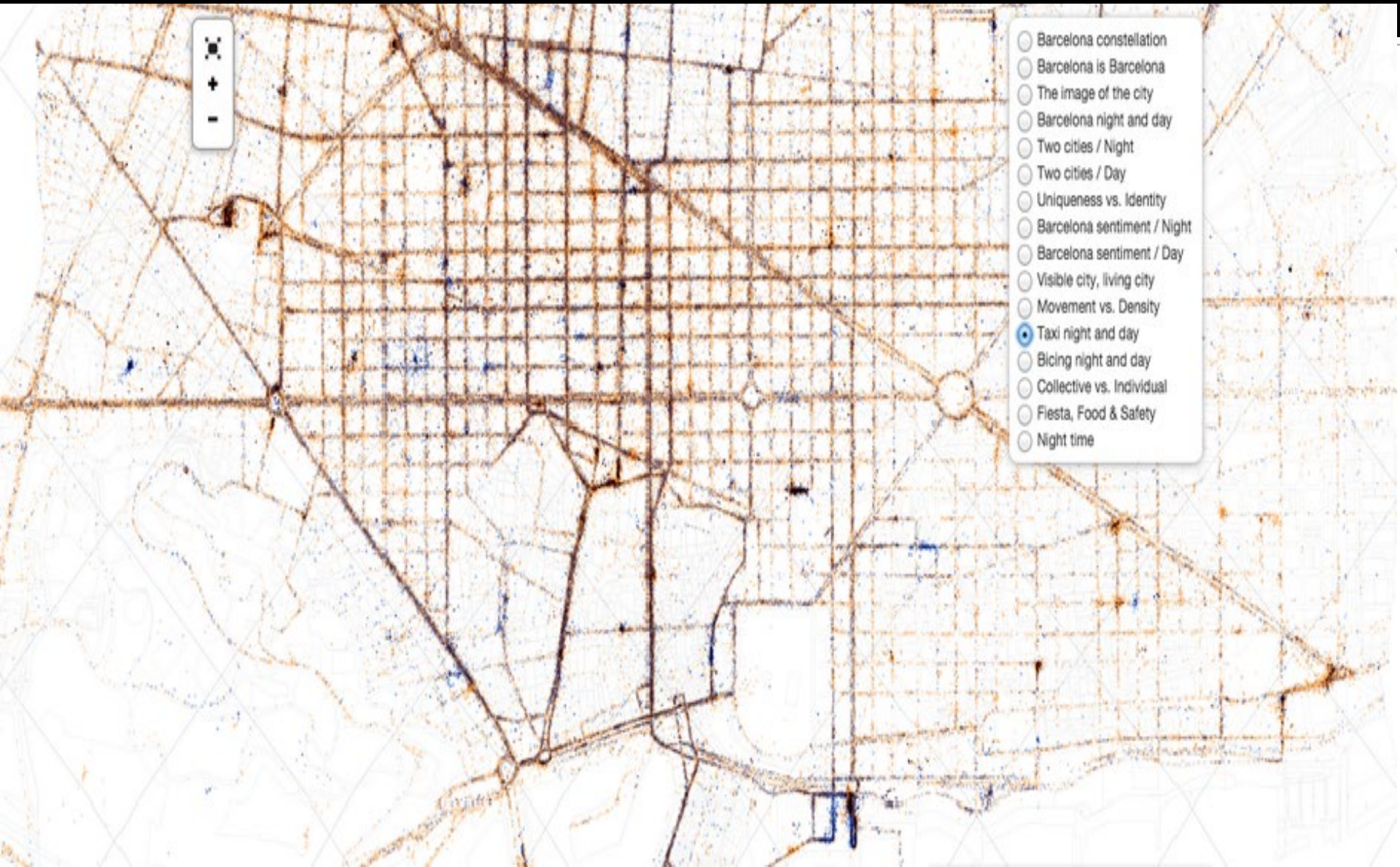
<http://www.atnight.ws/>



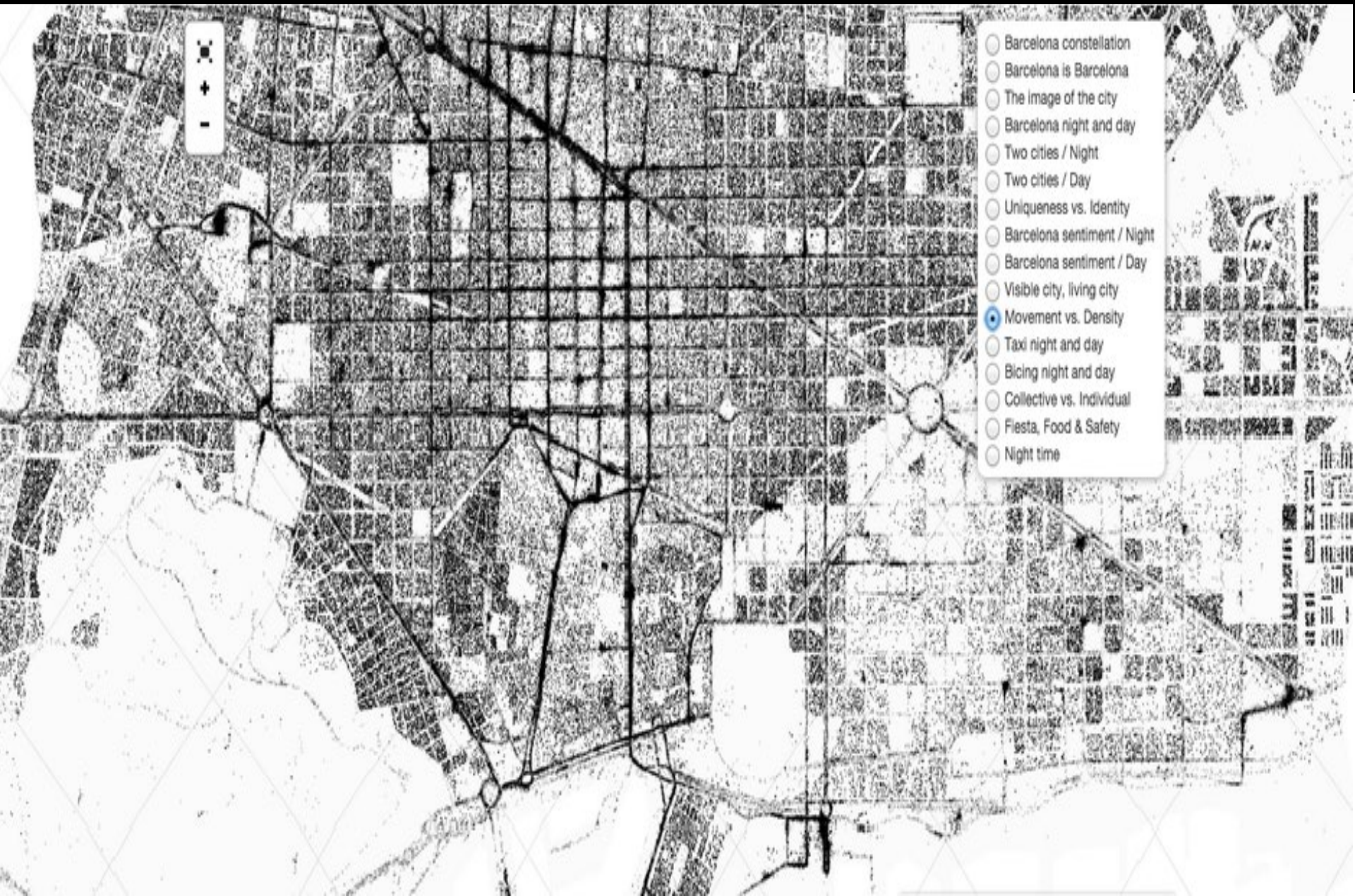
Designing the City at Night, bike storage data



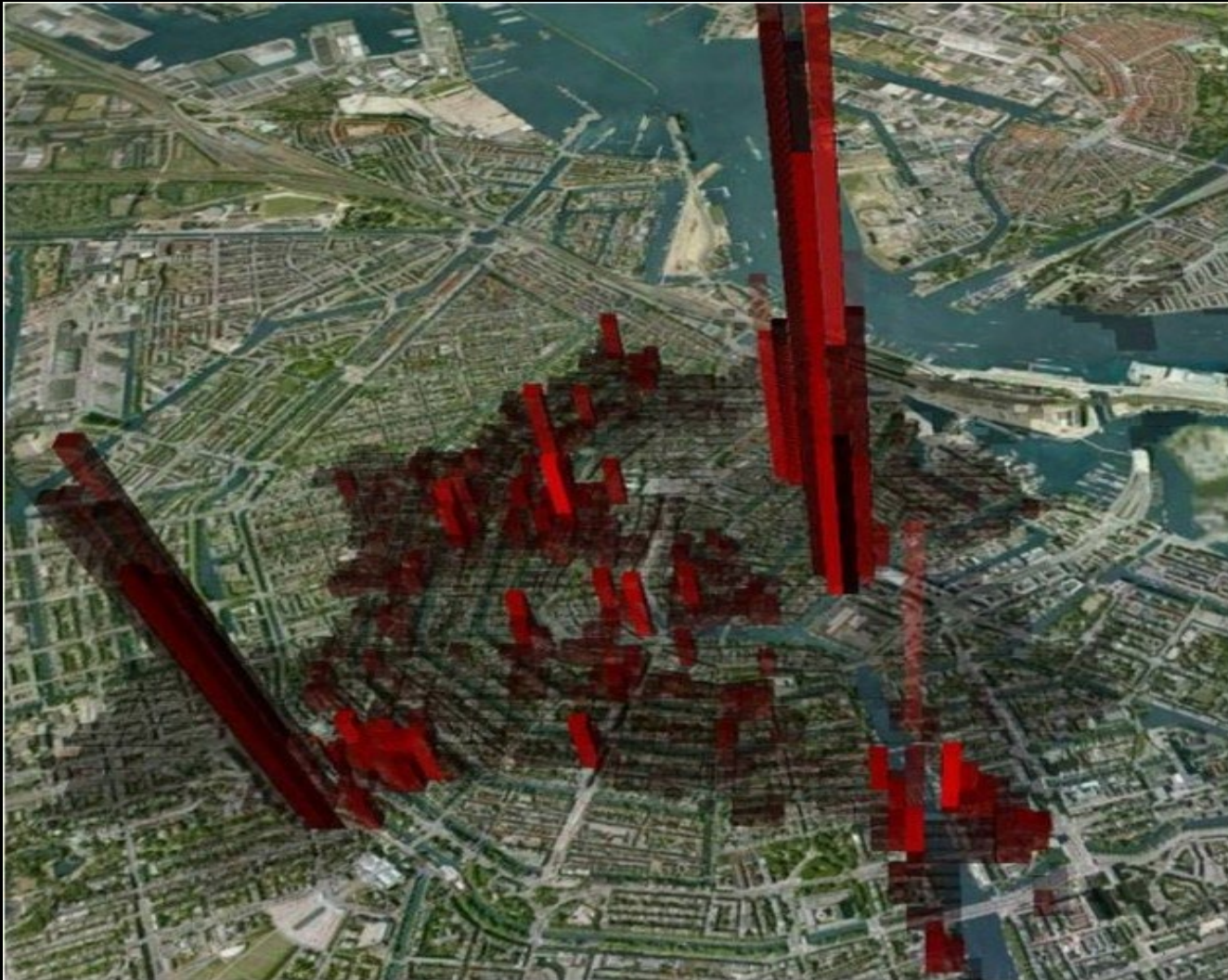
Designing the City at Night, Taxis



Taxis vs Density



Visible Amsterdam (movement of crowds), Euro Beinat

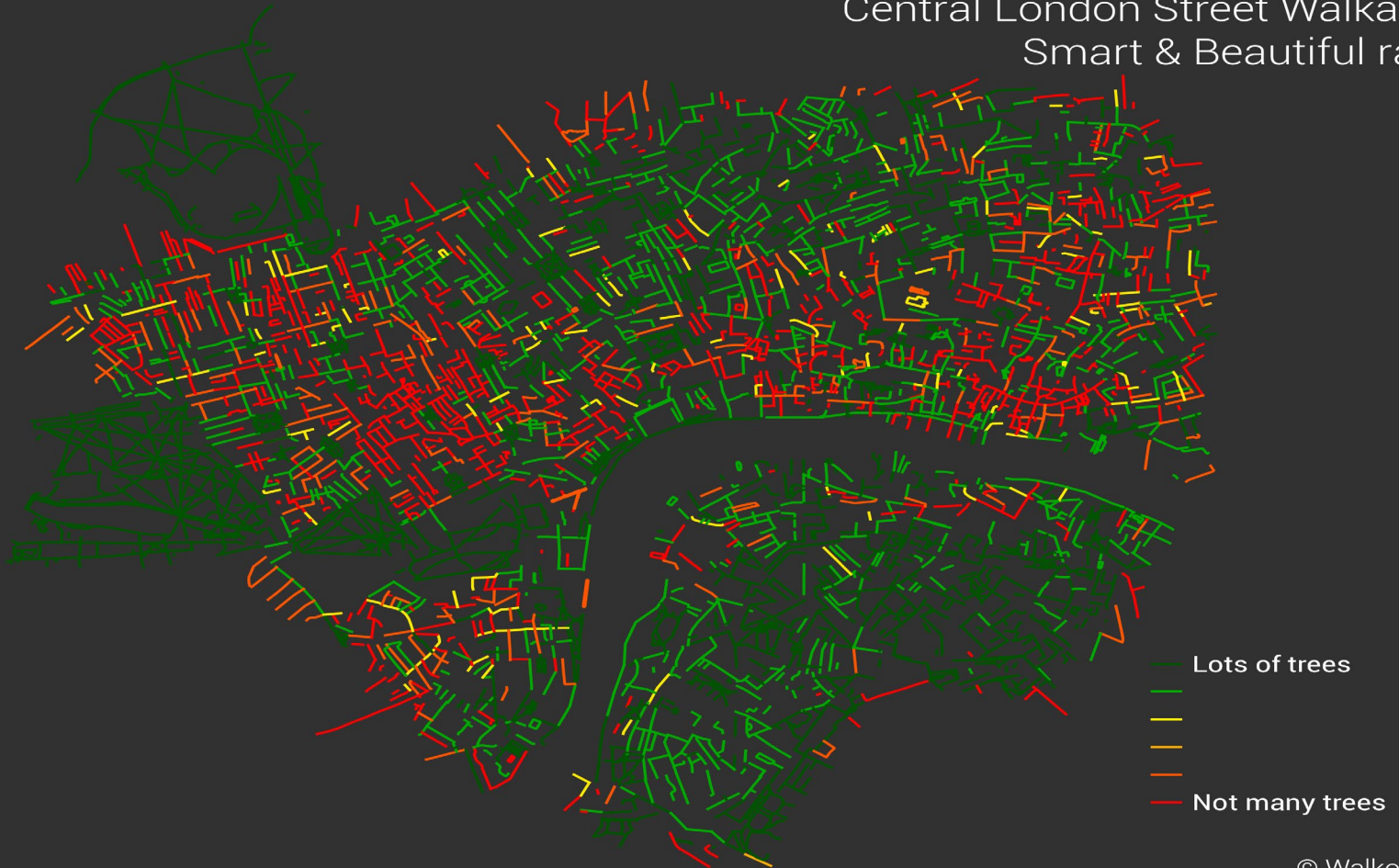


Walkable Streets Project

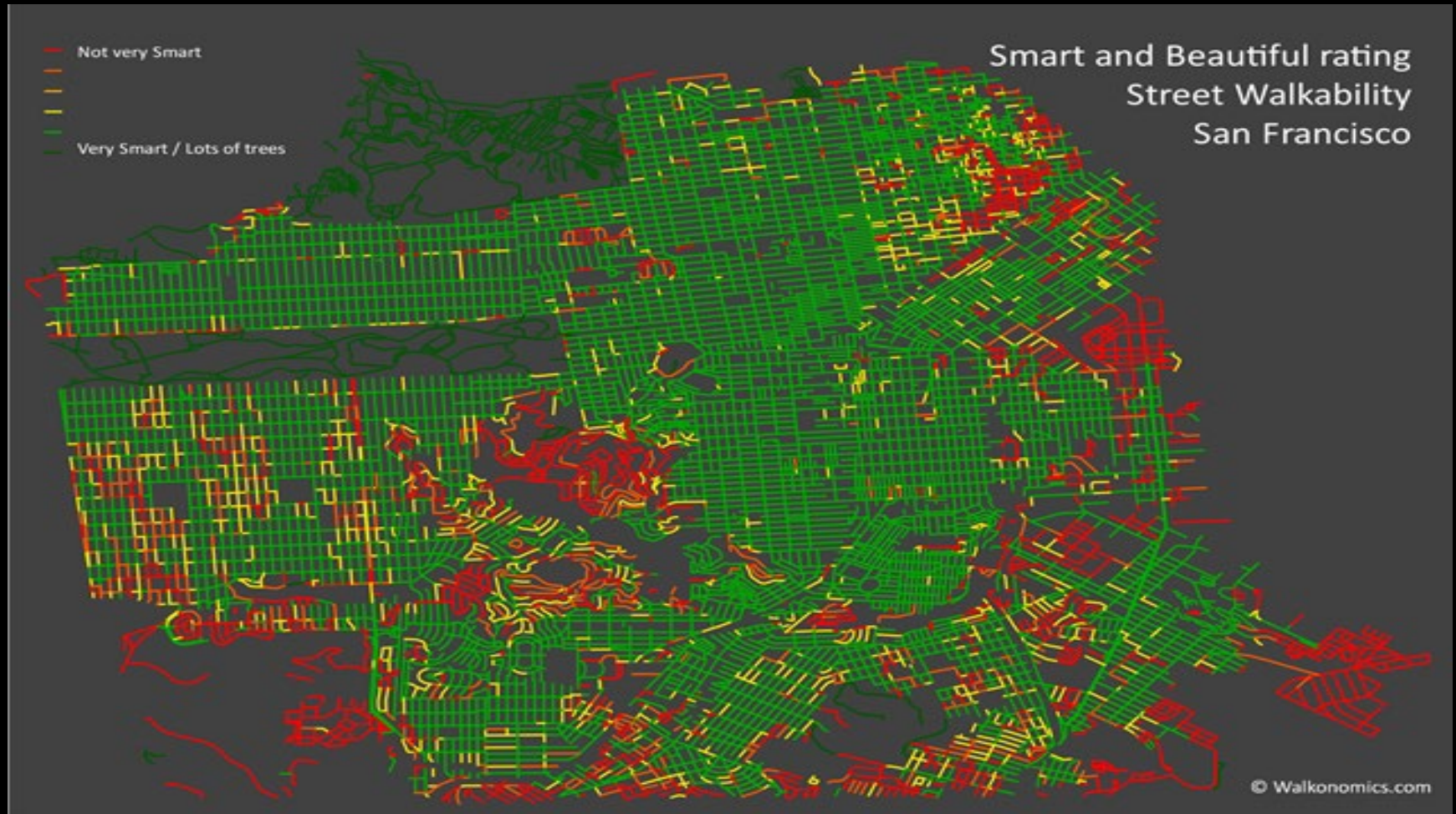
- ESRI is involved in modeling walkable streets, for example as a project with the City of Halton
- Complete Streets – understanding, modeling, simulating relationships between transportation modes (e.g. active/passive) and livability.

Walkable Streets Project

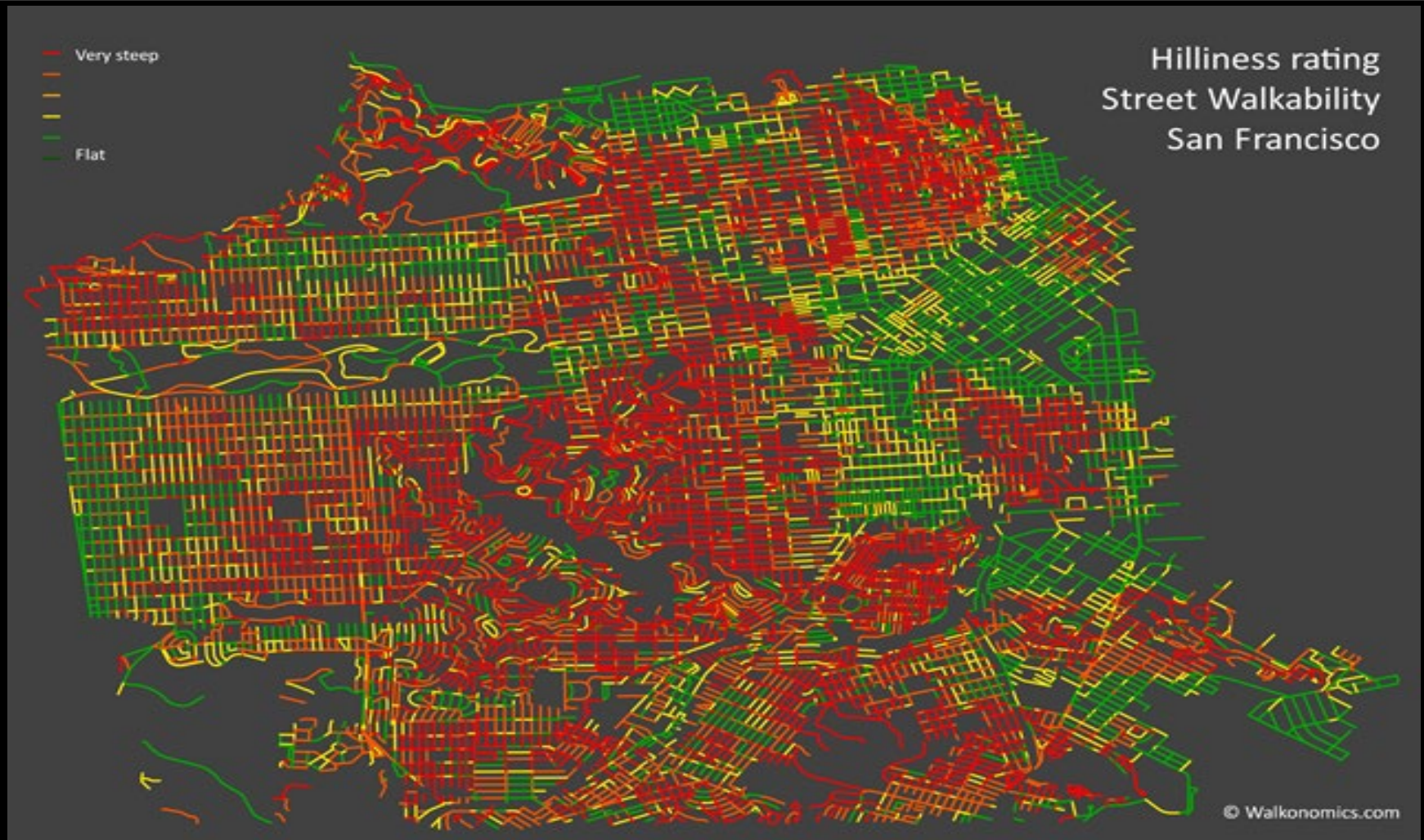
Central London Street Walkability
Smart & Beautiful rating



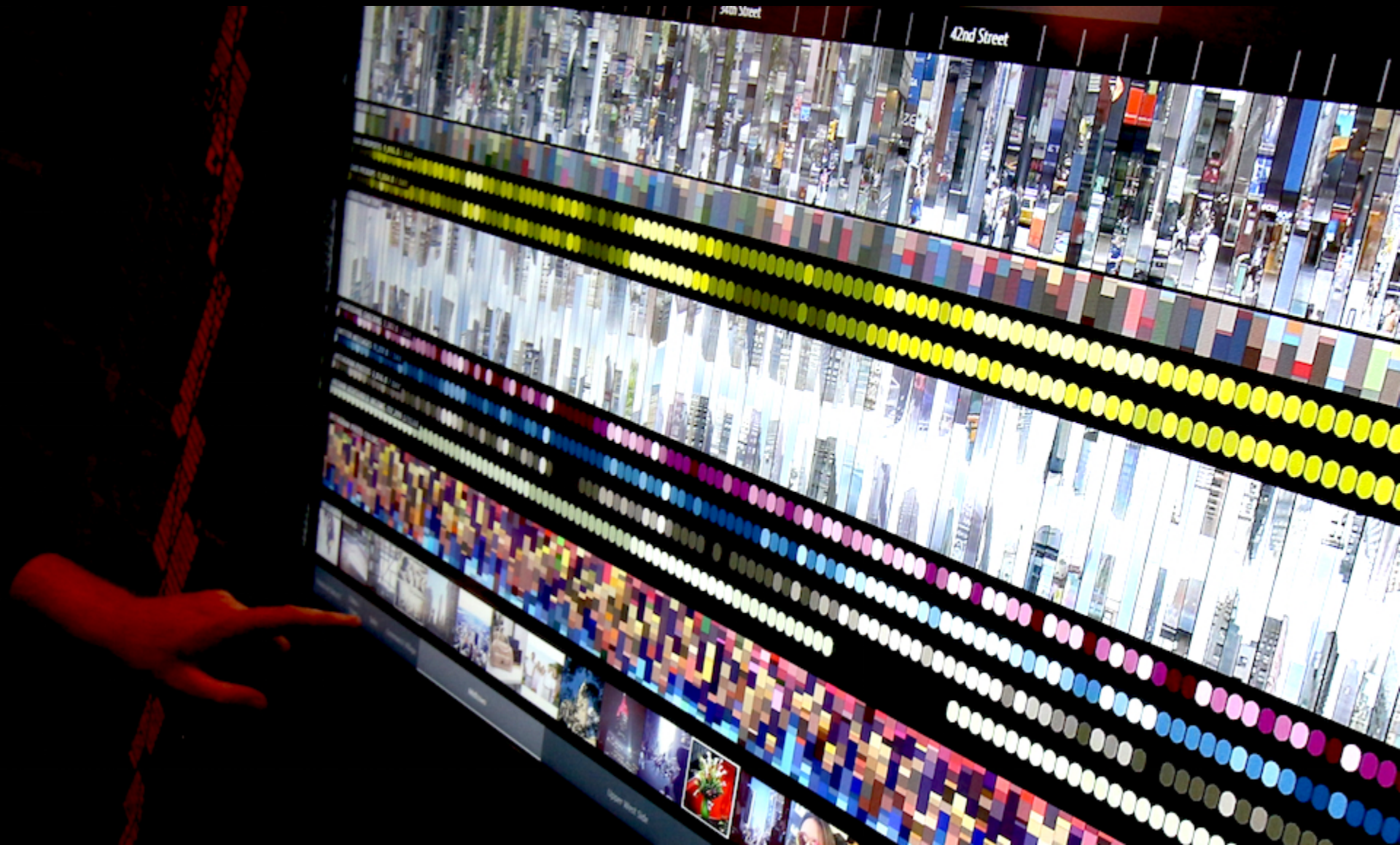
San Francisco



San Francisco



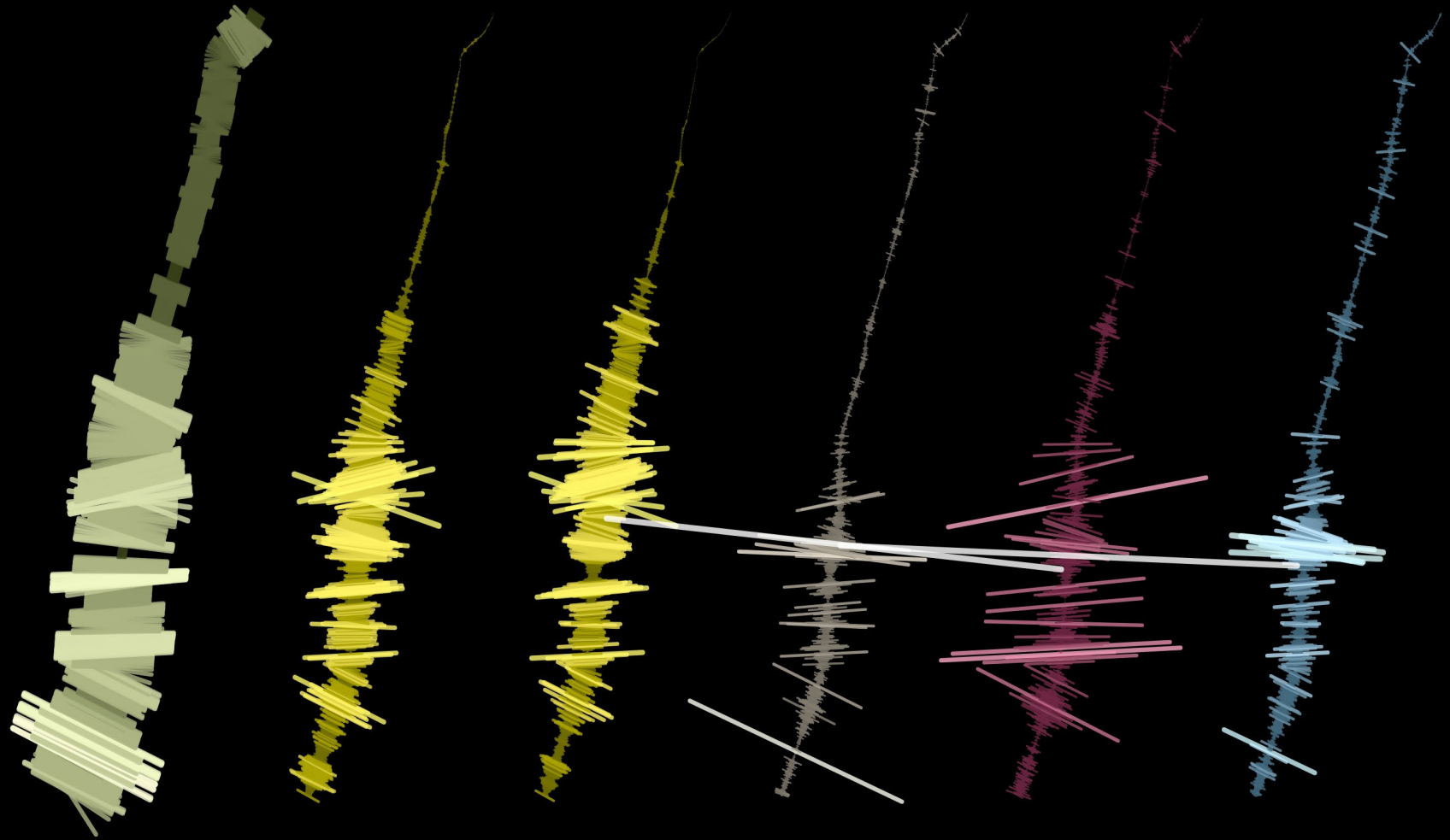
On Broadway, Manovich et al.



On Broadway

ON BROADWAY

<http://on-broadway.nyc>



HOUSEHOLD INCOME

TAXI DROP-OFFS

TAXI PICK-UPS

INSTAGRAM IMAGES

FOURSQUARE CHECK-INS

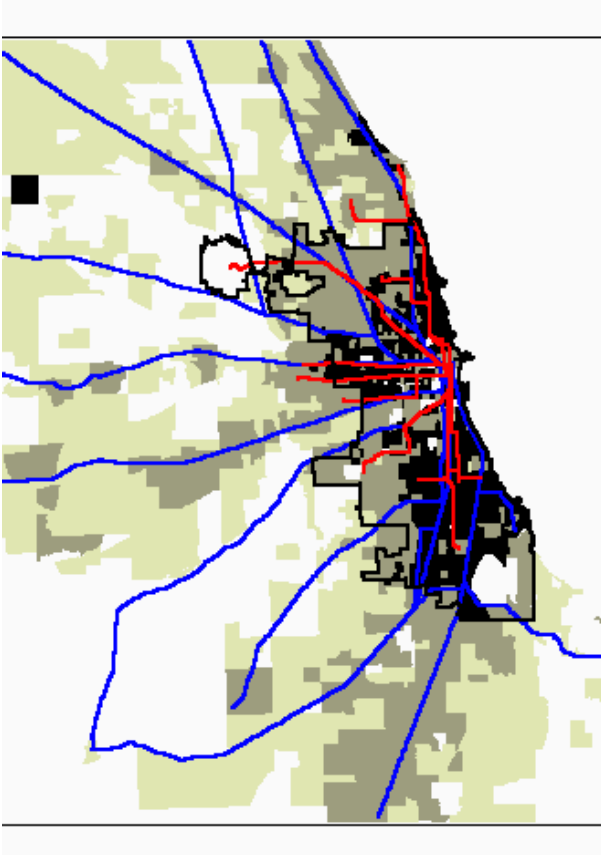
TWITTER MESSAGES

Cultural Analytics and the City



- Data is critical to understanding cultural change, impact and economics. It allows us to measure and address flourishing neighbourhoods and cultural deserts.
- Large (urban focused) cultural data sets – longitudinal study regarding arts participants. Eurobarometer survey on participation includes Canada, Australia and the EU.

What to measure?



- Economic Impact - “Culture attracts and retains creative professionals and their employers.
- Public Safety: Positive street life; revitalizes and sustains property values.
- Transforms lives of at-risk populations. Culture visitors regionally and globally, combats anonymity that drives communities apart.

Cultural Data Profile



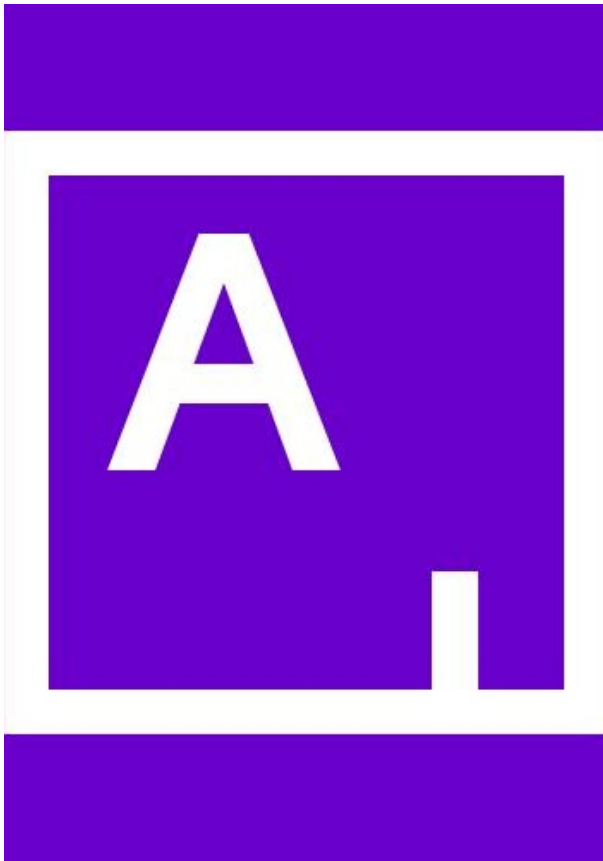
- <http://culturaldata.org/> Insight for the arts - NFP arts, culture and humanities organizations - collect and analyze their financial and audience/user data, and activities.
- Outputs - analytic reports; visualizations.
- OCAD U and Canadian Museum of Science – analytics project.
- Collect biometric engagement data.

Chicago Cultural Plan



- Strong Neighbourhoods, Innovation, Environmental Sustainability (reuse and alternative transportation), Public Health, Lifelong Learning, Public Safety, Well-being and quality of life. Measure impacts - Culture as cohesive
- “Artist360,” measure sector-wide fellowship of rotating artists in other sectors to incorporate creative skills into other sectors.

Cultural Tourism



- Need real time aggregated content that encourages them to explore cultural experiences, venues.
<https://www.artsy.net>
/ Discover, research and collect the world's best art. Guide to art fairs, location aware.

Clustering/Affordability/ Transportation – Visualize Impacts



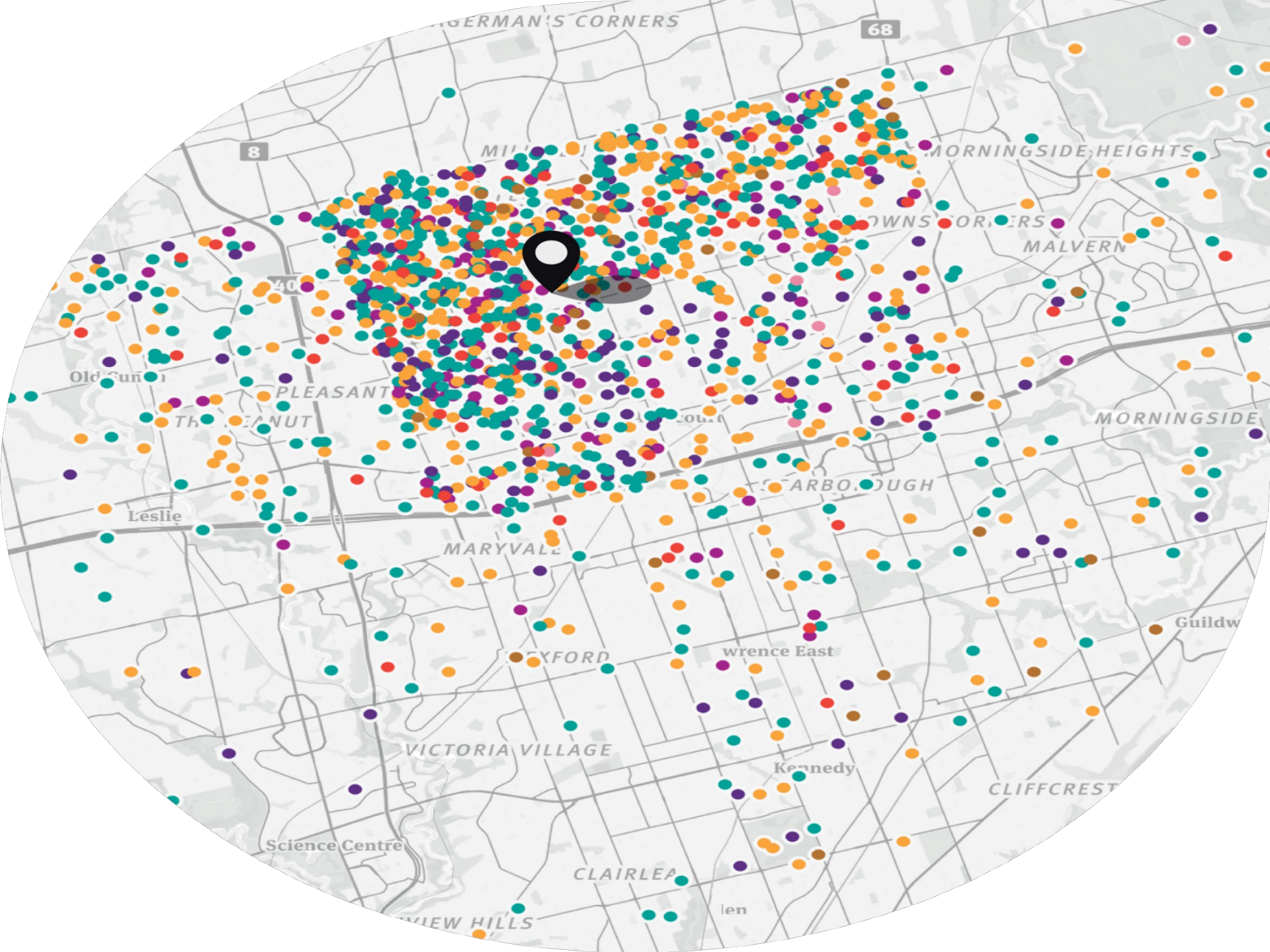
- Develop and measure mixed neighbourhoods versus gentrification – creative centres, businesses, creative industries, live/work spaces.
<http://www.torontoartscape.org/>
- Find talent fast through just in time network .
- Affordable housing, health care, childcare – access to content was one of the three top drivers for choosing a city.

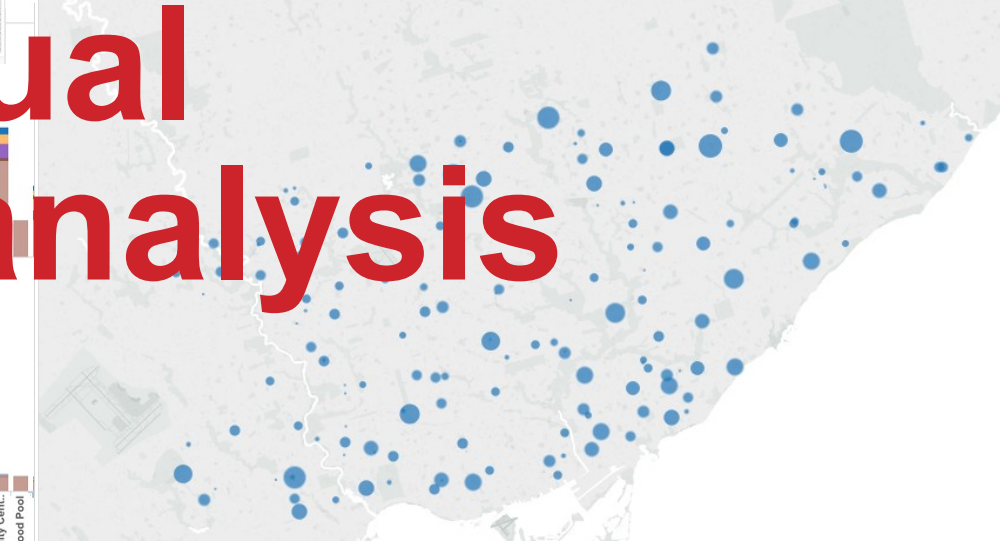
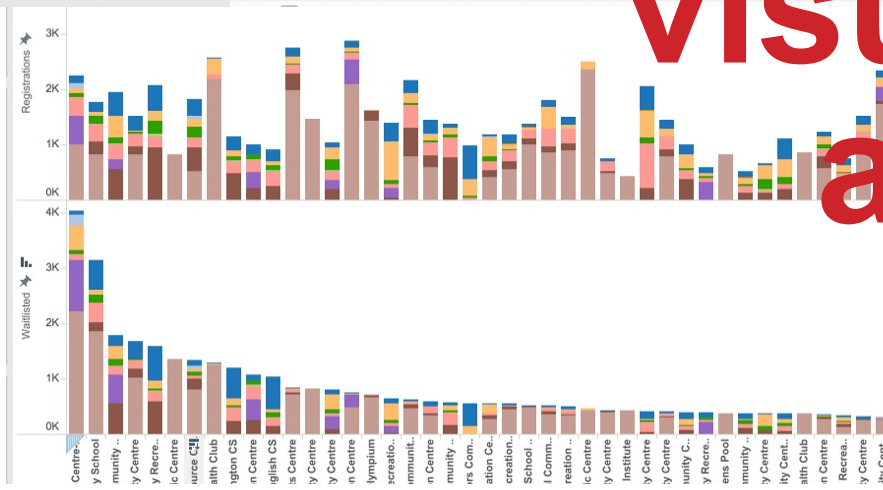
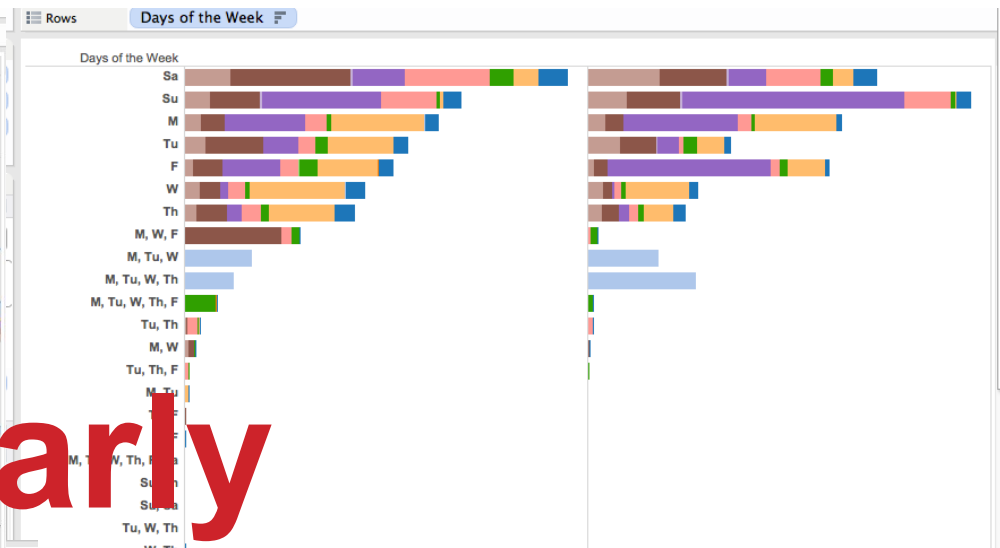
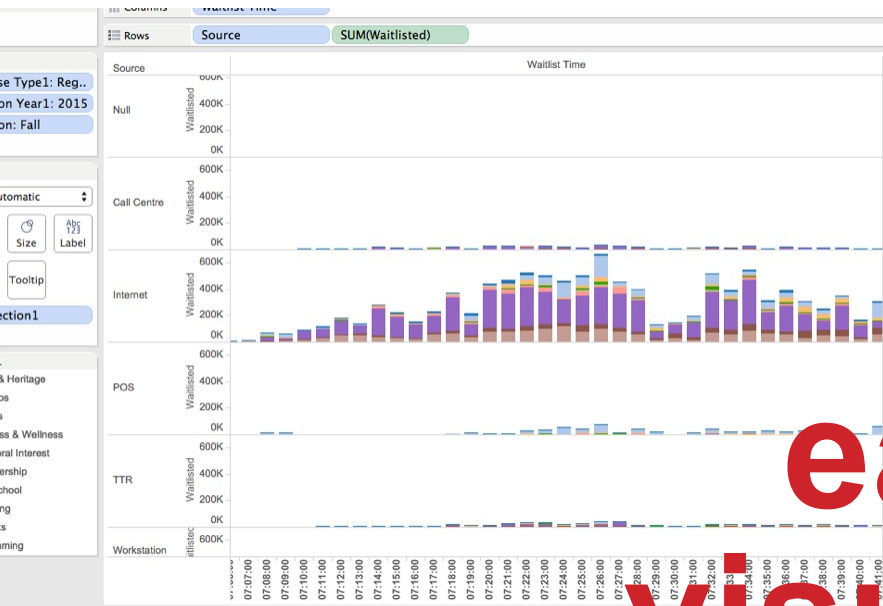
Citizen/Resident Focused

- “Building Smart Cities for Smart Citizens”
Phillips, 2016.
- Find and use services.
- Increase participation in smart city initiatives.
- 2-way communication government and residents.
- Increased innovation using data.
- Ability to offer personalized services, alerts, offers.

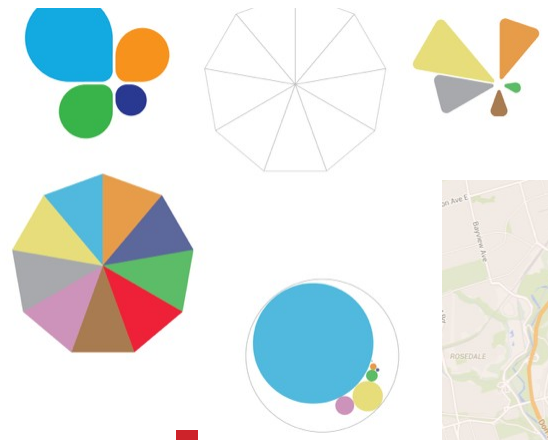
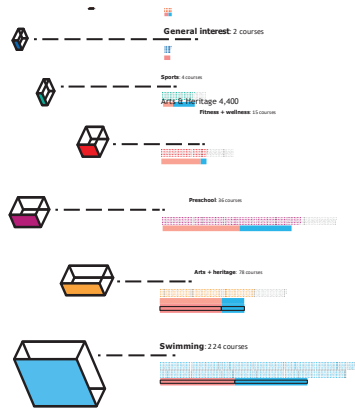
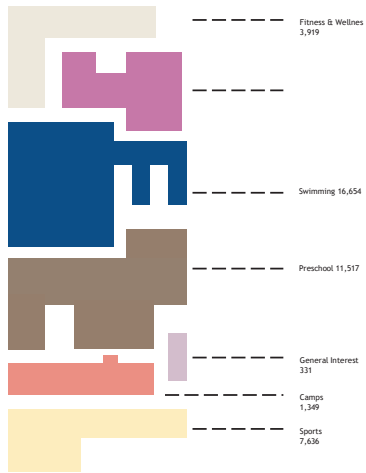
Open Data and City Resource Access

- OCAD University and the City of Toronto, Mayor's Office and Parks and Recreation.
- Analyze and represent data from recreation centres.
- Understand the changing nature of demand over time, services available.
- Explain and then solve problem of sign-up crunch through visualization.

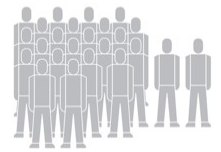
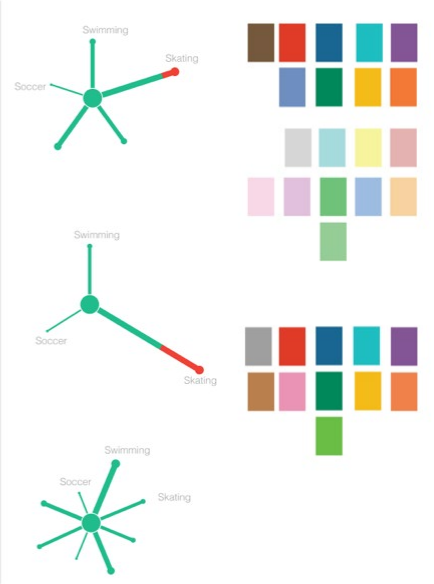
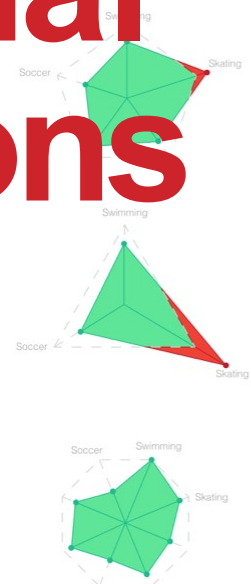
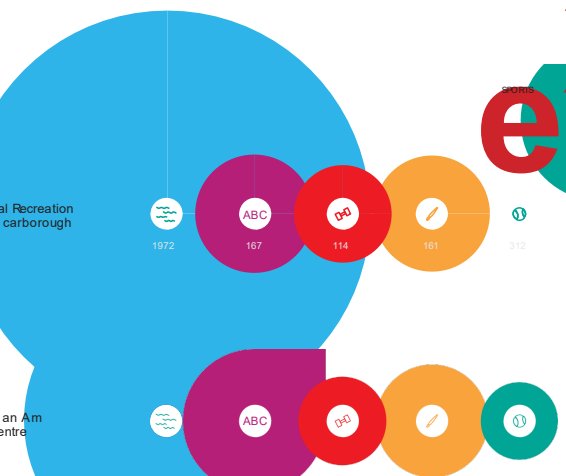




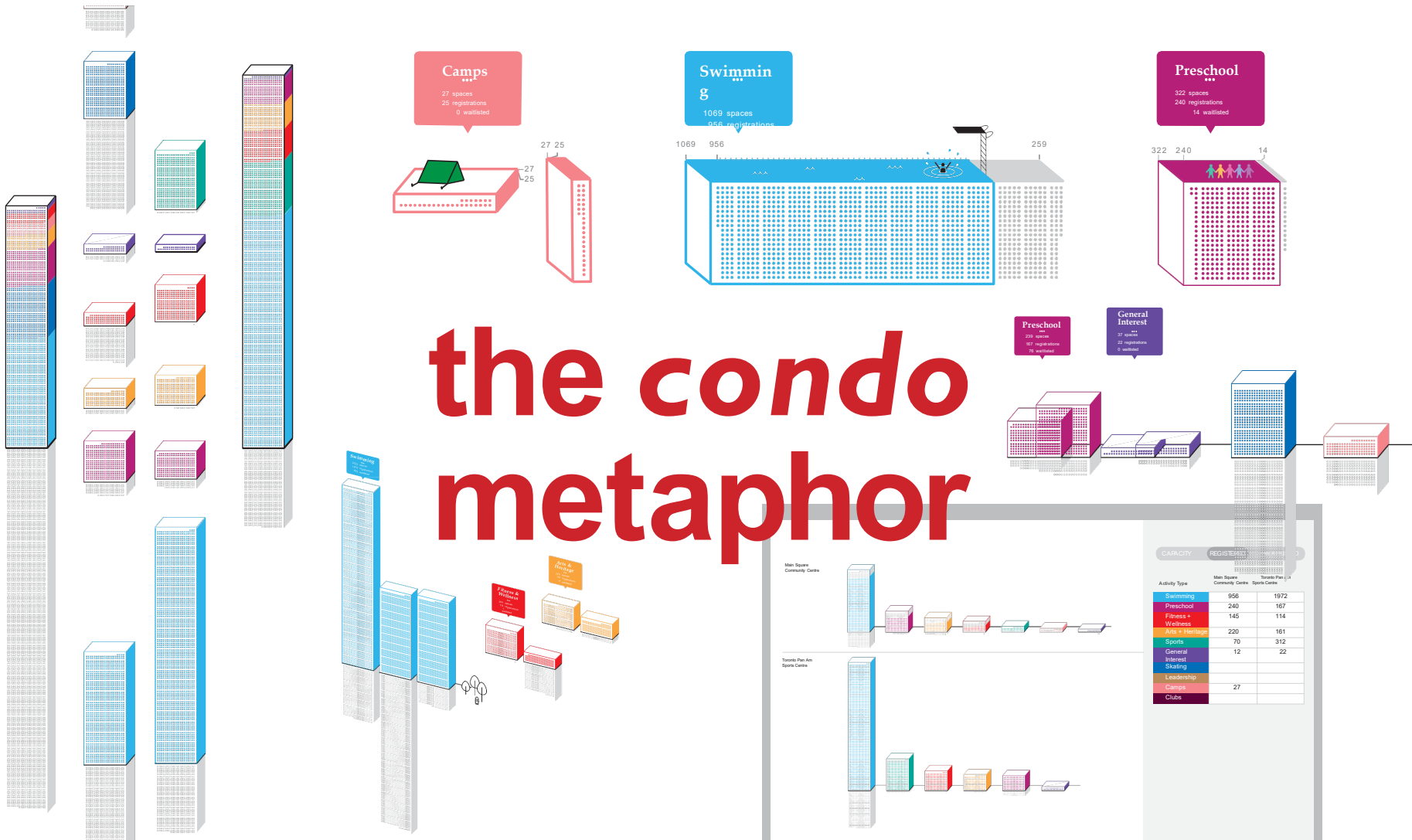
early
visual
analysis

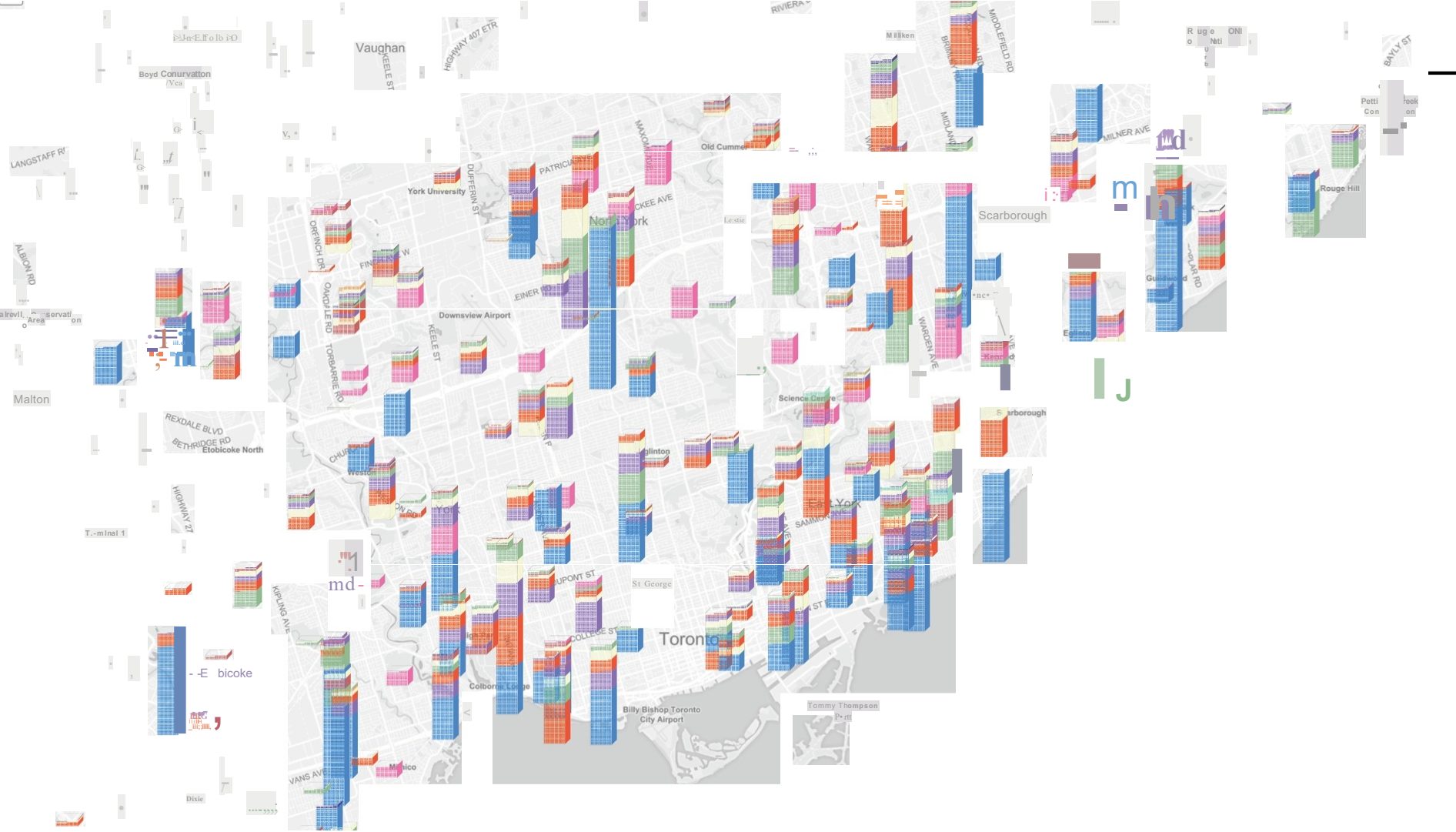


early visual explorations

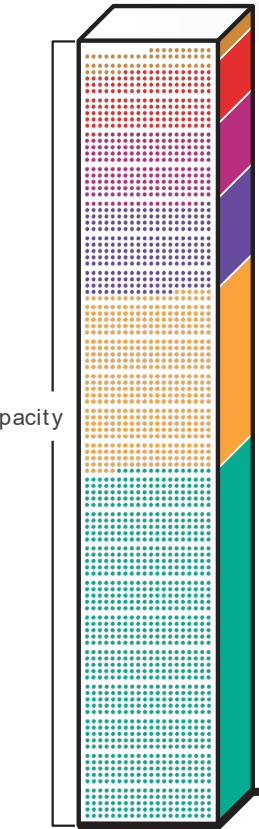


the condo metaphor

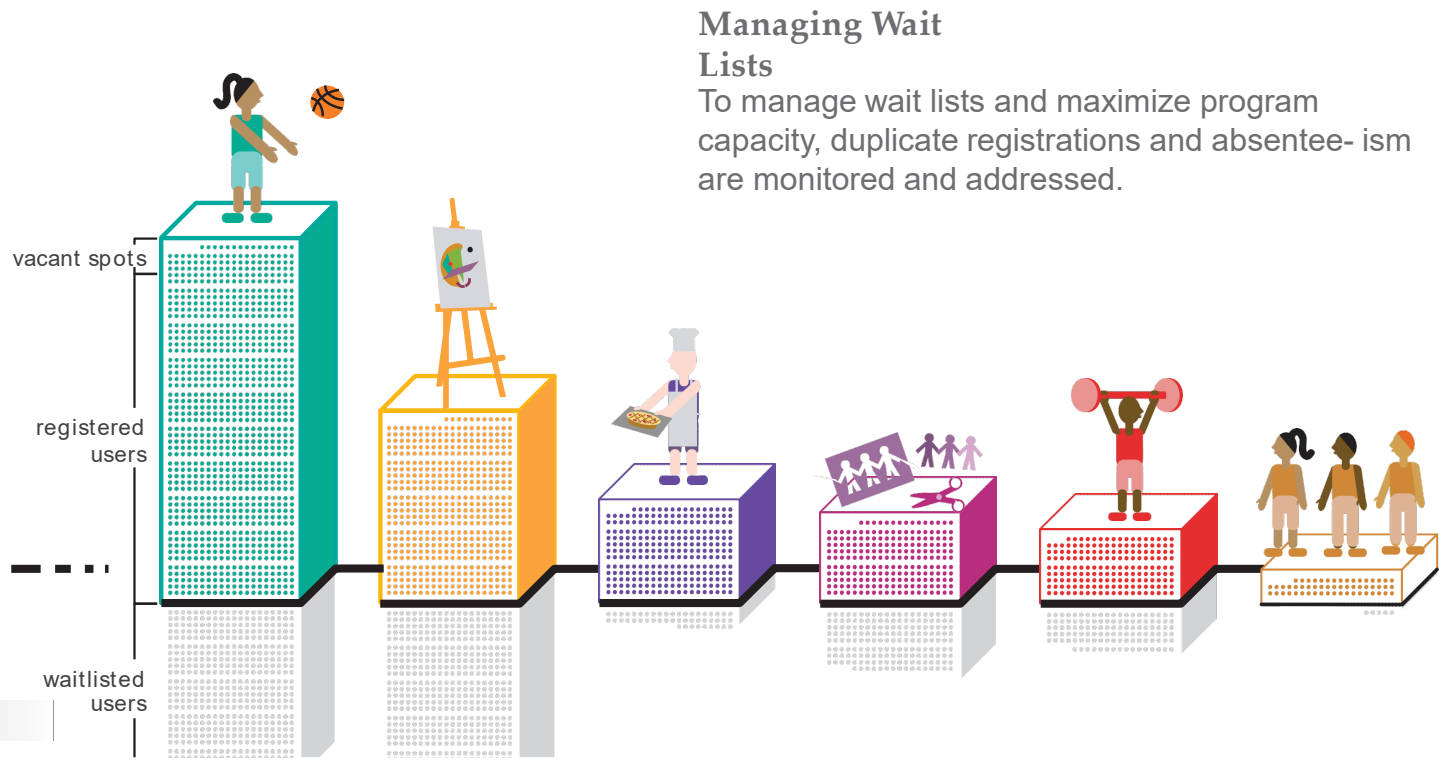




Capacity	1015	511	256	215	177	56
Vacant spots	68	54	7	19	0	10
Registered users	947	457	249	196	177	46
Waitlisted users	473	511	49	176	116	5



Centre Totals
Capacity 2230



Managing Wait Lists

To manage wait lists and maximize program capacity, duplicate registrations and absenteeism are monitored and addressed.

Edithvale Community Centre

The Edithvale Community Centre, established in 1984 in the former Edithvale Public School, quickly became a hub for the community and has housed more than 50 local groups in its history.

The new Edithvale Community Centre was designed with extensive community input and opened in October 2010. It features a double gymnasium, banquet hall, youth lounge, seniors' lounge, two early years rooms, a demo/cooking kitchen, three craft rooms, fitness and dance studios, a weight room and an indoor, elevated walking/running track.

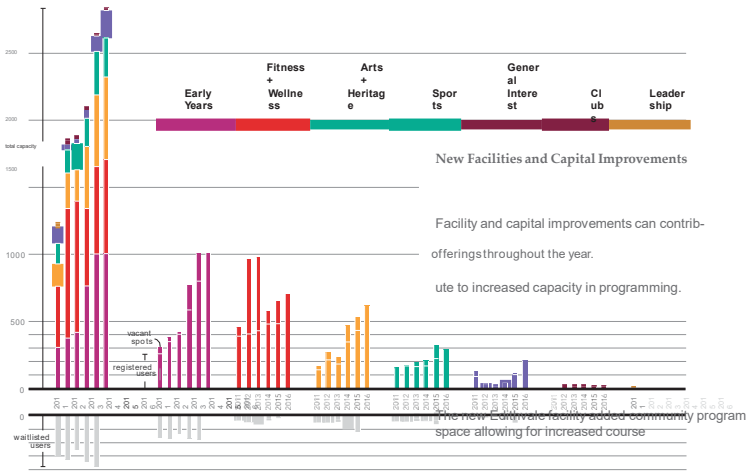
The centre is conveniently located near public transit. There is also a path leading to the centre for walkers and cyclists as well as ample bicycle parking.

Data shown on these graphics does not include drop-in programs.

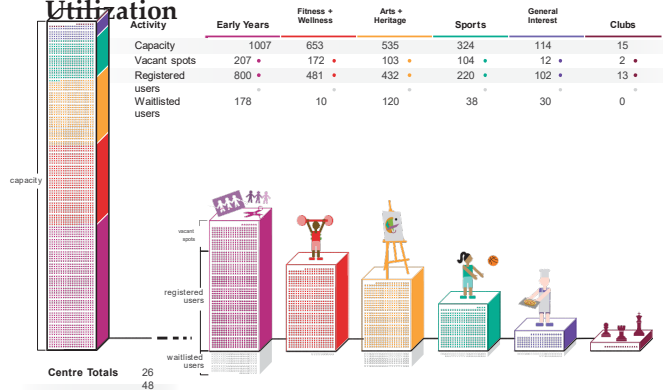


NORTH DISTRICT
131 Finch Ave W
North York

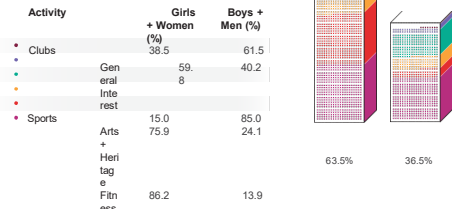
2011–2016: Fall Registered Program Utilization



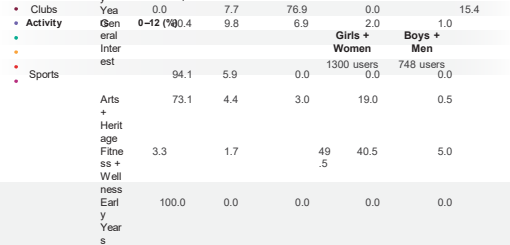
2015: Fall Registered Program Utilization



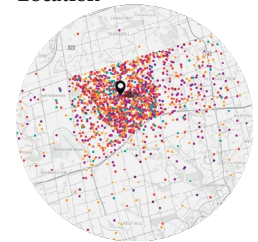
Enrollment by Gender



Enrollment by Age



Enrollment by Location



Residents First
Residents are given priority for ten days following the start of a registration period.

Non-residents must pay a non-resident fee (including at centres where programs are free).

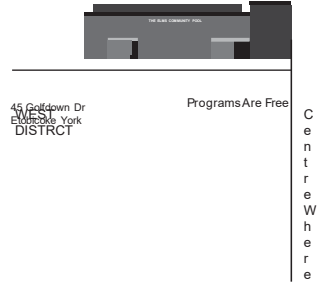
Age Group	Registered Users	Percentage
0-12	13	2.5%
13-24	24	4.8%
25-59	5	0.9%
60+	268	53.6%
Unspecified	279	55.8%
Total	1421	100%

The Elms Community School and Pool

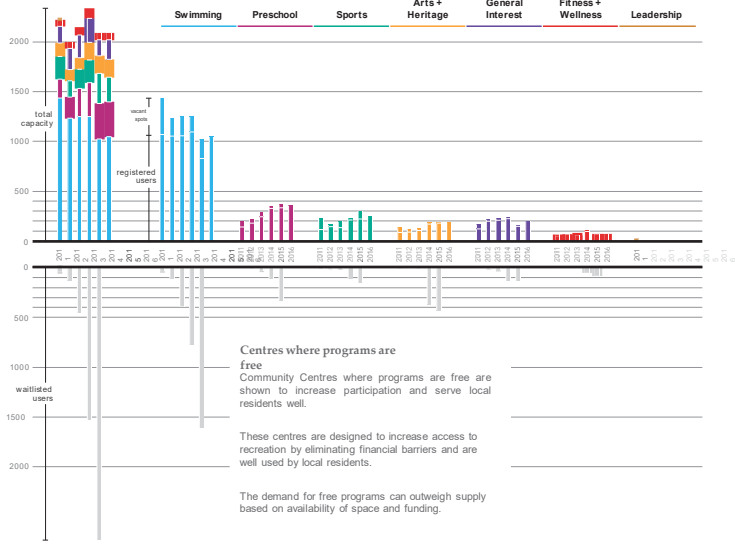
The Elms Community School and Pool is located east of Islington Avenue, north of the 401. Nestled between a Public and Catholic school in a quiet residential area.

This facility became a centre where programs are free in fall of 2014. The Elms Community School and Pool offers a wide variety of programs for all ages including fitness, child/youth/adult swimming lessons, sports, art, summer camps, and special events.

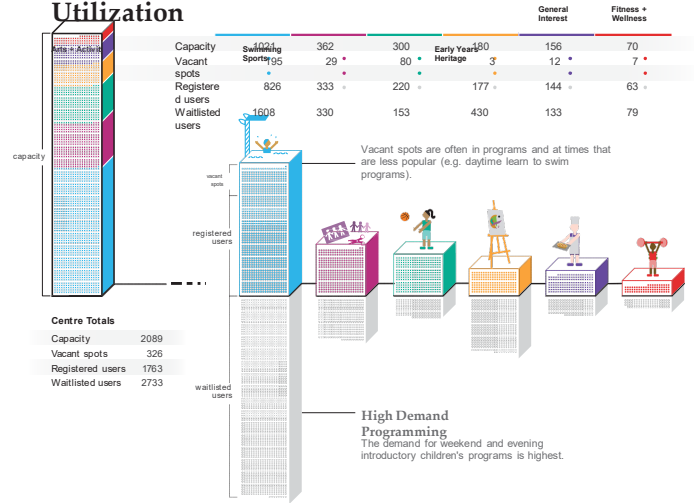
Data shown on these graphics does not include drop-in programs.



2011-2016: Fall Registered Program Utilization

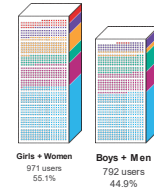


2015: Fall Registered Program Utilization



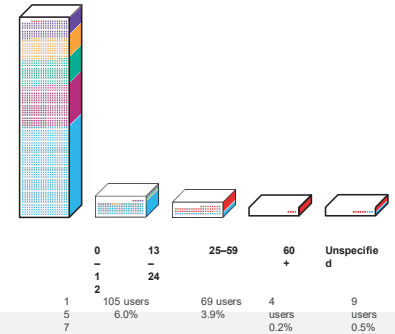
Enrollment by Gender

Program	Girls + Women (%)	Boys + Men (%)
Fitness + Wellness	90.5	9.5
General Interest	54.2	45.8
Arts + Heritage	79.1	20.9
Sports	37.3	62.7
Early Years	52.6	47.4
Swimming	53.1	46.9



Enrollment by Age

Program	0-12 (%)	13-24 (%)	25-59 (%)	60+ (%)	Unspecified (%)
Fitness + Wellness	7.9	3.2	73.0	6.3	9.5
General Interest	3.8	6.3	0.0	0.0	0.0
Arts + Heritage	97.2	2.3	0.6	0.0	0.0
Sports	2	95.9	4.1	0.0	0.0
Early Years	100.0	0.0	0.0	0.0	0.0
Swimming	87.2	9.8	2.7	0.0	0.4



Enrollment by Location



Distance Travelled
Distance travelled for aquatic programs is often related to the proximity of swimming pools in the area.

L'Amoreaux Community Recreation Centre

on the corner of Kennedy Road and McNicoll Avenue. The centre is attached to the south side of the Mary Ward Catholic High School. The centre shares a gym with the school and has a dedicated fitness centre and early years room.

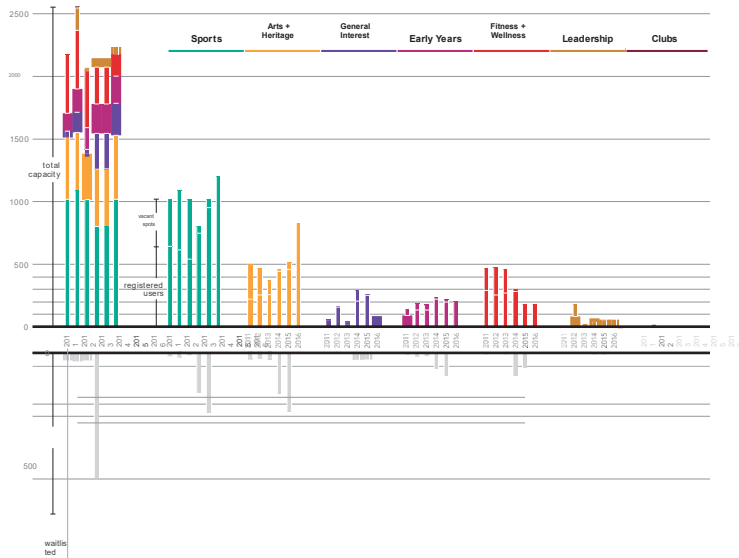


EAST DISTRICT Centre Where Programs Are Free
2000 McNicoll Avenue Scarborough

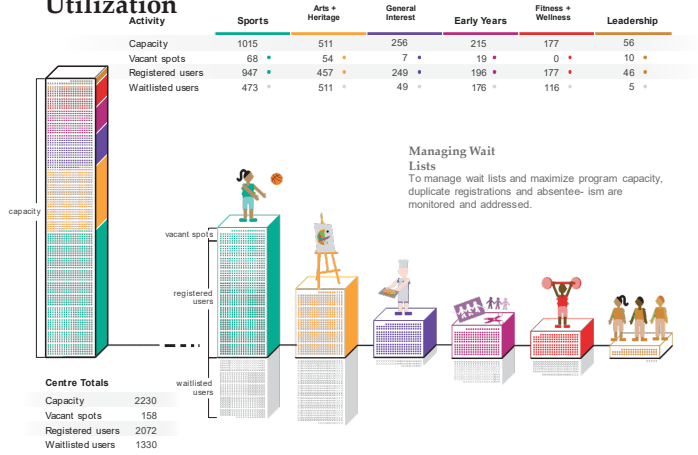
The centre offers early years, arts and crafts, dance, sports and fitness programs for children, youth and adults. During the day the centre runs extensive older adults programming in arts and crafts, dance, social program, billiards, computer as well as special excursions. L'Amoreaux became a centre where programs are free in September 2014.

Data shown on these graphics does not include drop-in programs.

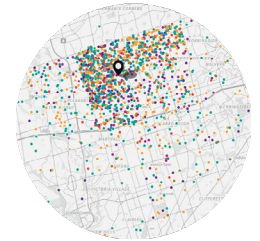
2011-2016: Fall Registered Program Utilization



2015: Fall Registered Program Utilization

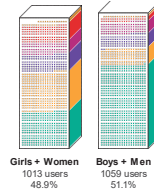


Enrollment by Location



Enrollment by Gender

Activity	Girls + Women (%)	Boys + Men (%)
Leadership	63.0	37.0
Fitness + Wellness	79.8	19.7
Early Years	49.0	51.0
General Interest	56.2	43.8
Arts + Heritage	70.0	30.0
Sports	30.2	69.8



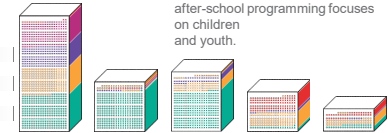
Maximizing Space

During the day, to maximize program space, the centre runs extensive older adult programming in arts and crafts, dance, social programs, special excursions, billiards, and computers.

Enrollment by Age

Activity	0-12 (%)	13-24 (%)	25-59 (%)	60+ (%)	Unspecified (%)
Leadership	0.0	50.0	34.8	4	10.9
Fitness + Wellness	6.7	7.9	0.0	6	23.0
Early Years	100.0	0.0	0.0	0	0.0
General Interest	69.9	4.8	16.5	6	2.4
Arts + Heritage	46.6	1.8	15.1	2	11.2
Sports	30.3	31.8	32.2	2	3.5

This facility is attached to a high school and after-school programming focuses on children and youth.



0-12
882 users

13-24
59

358 users

25-60+
Unspecified

431

Jimmie Simpson Recreation Centre

A large facility located on Queen Street East in Jimmie Simpson Park. This location is a hub for recreation programming with a variety of opportunities for all age groups. It offers a range of activities including swimming, fitness, sports, after-school, early years and youth programming. Jimmie Simpson is one of the original centres where programs are free.



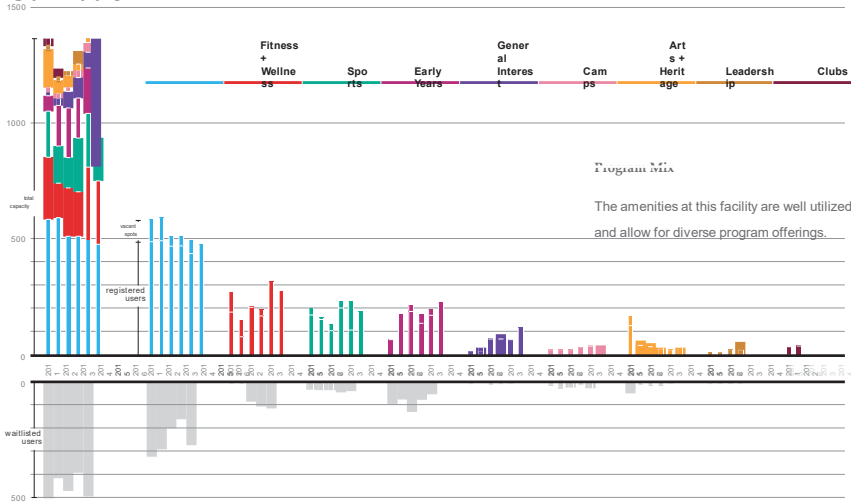
SOUTH DISTRICT
870 Queen St E
Toronto & East York

Centre Where Programs Are Free

Jimmie Simpson Artificial Ice Rink is location in the park and features a hockey pad which doubles as a pleasure pad. There are change rooms for changing into skates nearby. There are also tennis courts and a soccer field in the park.

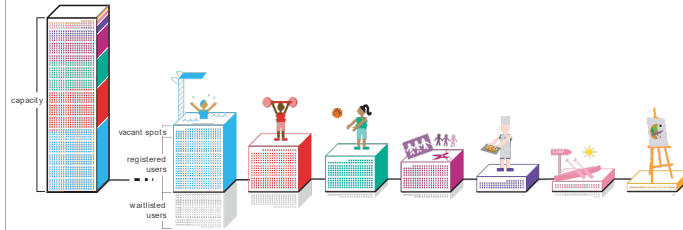
Data shown on these graphics does not include drop-in programs.

2011–2016: Fall Registered Program Utilization



2015: Fall Registered Program Utilization

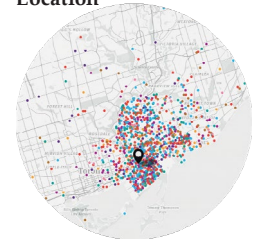
Program	Swimming	Fitness + Wellness	Sports	Early Years	General Interest	Camps	Arts + Heritage
Capacity	496	315	231	196	88	40	20
Vacant spots	60	0	124	26	3	2	2
Registered users	486	315	107	170	65	38	18
Waitlisted users	296	110	35	49	1	23	1



Centre Totals

Capacity	1366
Vacant spots	217
Registered users	1149
Waitlisted users	515

Enrollment by Location

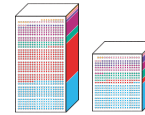


Facility of Choice

While most participants live nearby the facility they use, some choose a centre close to work or childcare. Distance travelled can also be related to transit proximity or unique program offerings.

Enrollment by Gender

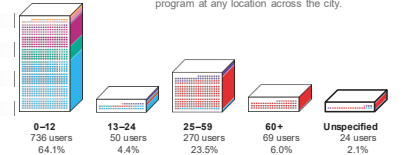
Program	Girls + Women (%)	Boys + Men (%)
Arts + Heritage	83.3	16.7
Camps	50.0	50.0
General Interest	29.2	70.8
Early Years	67.6	32.4
Sports	47.4	52.6
Fitness + Wellness	89.5	10.5
Swimming	53.4	46.6



Girls + Women: 730 users
Boys + Men: 419 users

Enrollment by Age

Program	0-12 (%)	13-24 (%)	25-59 (%)	60+ (%)	Unspecified (%)
Arts + Heritage	94.4	5.6	0.0	0.0	0.0
Camps	97.4	0.0	0.0	0.0	2.7
General Interest	18.5	15.4	56.9	1.5	7.7
Early Years	100.0	0.0	0.0	0.0	0.0
Sports	95.7	4.3	0.0	0.0	0.0
Fitness + Wellness	0.0	2.9	70.3	21.9	4.9
Swimming	89.2	5.7	4.1	0.2	0.7



Residents are eligible to register for any program at any location across the city.

iCity research network premise

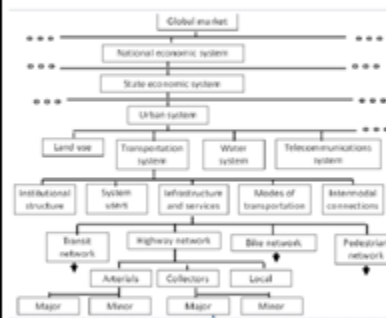
- iCity led by Dr. Eric Miller, UT, with OCAD U, U. Waterloo, IBM, ESRI, Cellint, City of Toronto, Waterfront Toronto, and other partners - *urban informatics* to the analysis of major urban transportation problems.
- **City science** builds upon traditional multi-disciplinary study of urban areas to develop an integrated, systemic understanding of urban systems at several levels: macro (region-wide), meso (individual systems, services, etc.) and micro (individual agents).

iCity Premise

- ***Informatics*** involves the acquisition, storage, management, curation, analysis and visualization of data.
- iCity is a computational “virtual lab” for analysis and design in which powerful, comprehensive computer models simulate the evolution of urban spatial socio-economic systems (transportation, the regional economy, etc.) in response to a wide variety of scenarios and policies.

iCity concept of city systems as nested structures

Figure 2: Hierarchical Approach to Urban Systems



Meyer & Miller (2013)

Each system decomposes into sub-systems; E.g., “the” transportation system consists of:

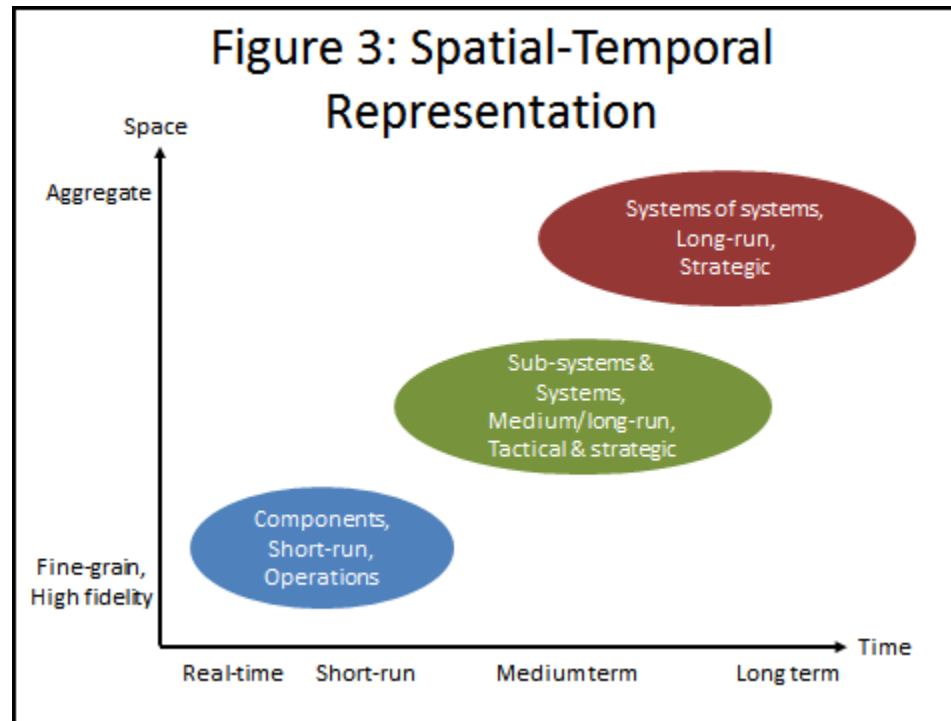
- The road system
- Transit system
- Active transportation system
- Operating agencies
-

Each “system” interconnects & interacts with other systems



Cities (urban regions) are “systems of systems”.

Modeling systems relationships



based on v.10 worksheet

StreetFactory
UrbanCanvas
UNA Toolbox
ArcGIS
Sketchup Viewer
Vectorworks
my.Sketchup
Sketchup
Revit
AutoCAD
Urban Design and Planning Software
Blender
CityGML
Fusion 360
Design Software
Solidworks

Ecopolicy Game simulation
UrbanSim
Simulation / Interaction / Games

Urban Design - Built Environment, neighbourhood planning

Cit'Ease
SmartCity
Infrastructure Management, Sustainability and Resilient Cities
UI - Urban Institute (GB)

Autocad Infaworks 3D
Flow Analytics
Sidewalk Labs
Livehoods

ViziCities

kodex

Designing Tomorrowland

Graphtrails
Navigation

Stamen map
Unfolding Maps

StreetMix

Mindmixer / Crunchbase
Local Data / PLANETIZEN
Civic Engagement

Storyfacets
User-Centric Visualization

Mapping

Maps & Surveys, property data
CityEngine
Carto

Textizen

Engagement Lab

QGIS
Blender GIS

Openstreetmap

Mapbox

CoUrbanize

ROCKETMAN

Quadstone

TRIPSPARK

CELLINT

Pantonium

IBM Watson IoT
Public

Transportation

Miovision

OneITS / CVST

Transport, land use, demographics

Land Use

ALBATROSS

TRANSITMIX

ILUTE

Private

Big Data & Analysis

Land Use Visualization

DRAM

4-D wide-area visualization tool

GoPark

Big Data

EDMONTON

Cube Land

Flow Analytics
Sidewalk Labs

Watson Internet of Things IOT Data

DELTA

TILT

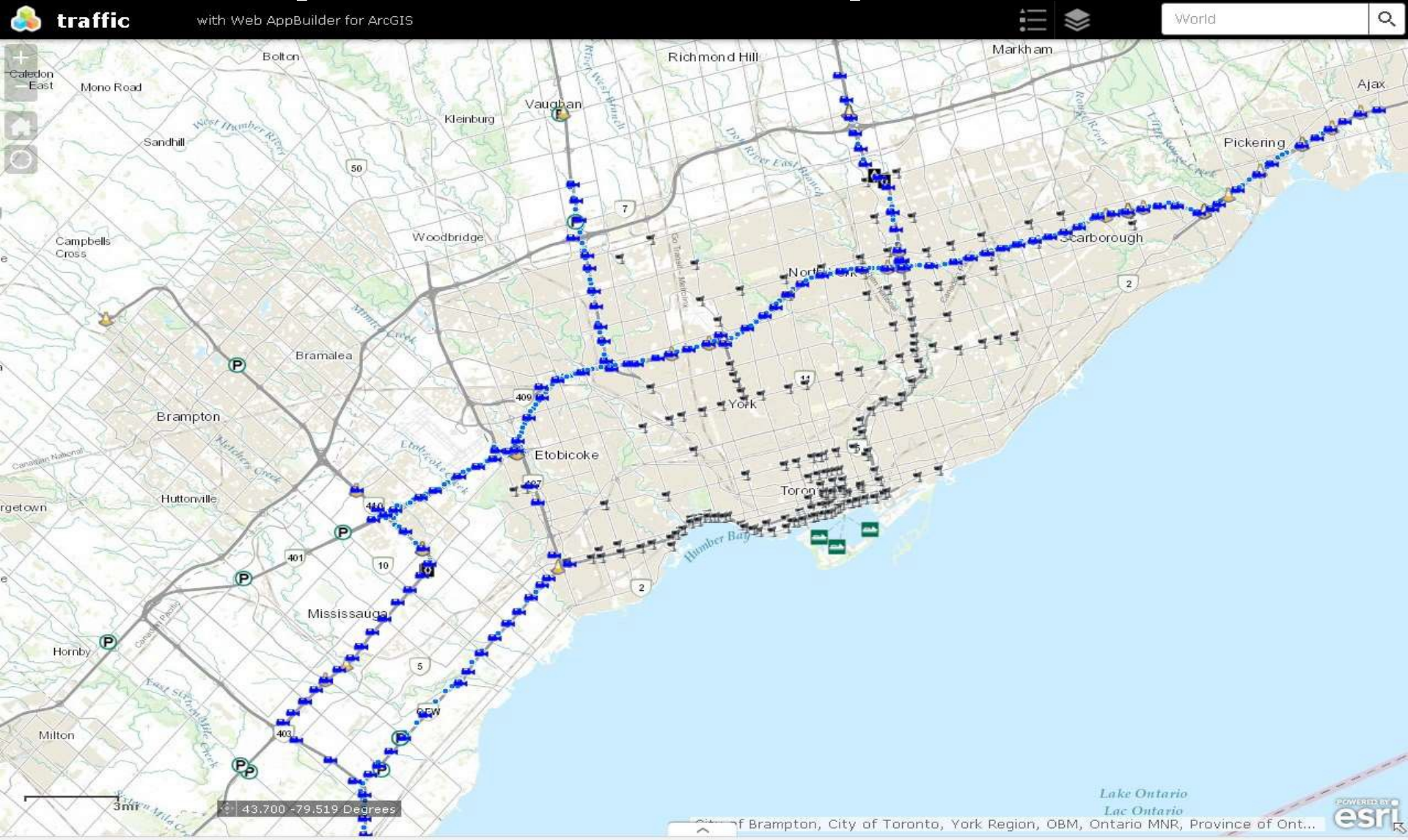
SimDELTA

CATEGORIES
iCity Comparative Toolsets

3D Visualization of Urban Space

- CityEngine ESRI.
- Modeling Toronto Waterfront.
- Transportation corridors.
- Complete Streets.
- Developing a Sketching capacity for rapid prototyping.

Visualization Tools for Transportation Analytics - ESRI






ESRI SAMPLES

The screenshot displays the 'My Neighbourhood Services Web App' interface. At the top, the header includes 'The City of BARRIE My Neighbourhood Services Web App', 'City of Barrie GIS', and 'ArcGIS Online App Gallery'. The main map area shows a residential neighborhood in Barrie, Ontario, with a yellow circle highlighting a search radius around '17 Nicholson Dr, Barrie, Ontario, L4N'. A 'Searched Location' popup shows the address. On the right, a panel titled 'My Neighbourhood Services...' provides a search bar with the address, a distance filter set to 1 kilometer, and a list of services with their counts:

Service	Count
Fire Stations	(1)
Schools	(2)
Transit Stops	(14)
Parks	(4)
Ward Boundaries	(1)
Garbage Pickup	(1)
Organics Pickup	(1)
Recycling Pickup	(1)
Yard Waste Pickup	(1)

Dashboard Example

Portland Traffic Fatalities & Serious Injuries, 2005-2014

Portland Bureau of Transportation    

All fatalities & serious injuries

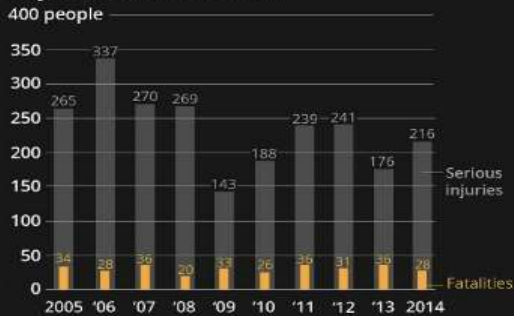
People in cars

People walking

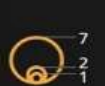
People on bicycles



Traffic fatalities & serious injuries - all modes, City of Portland, 2005-2014



Crash fatalities



Crash serious injuries

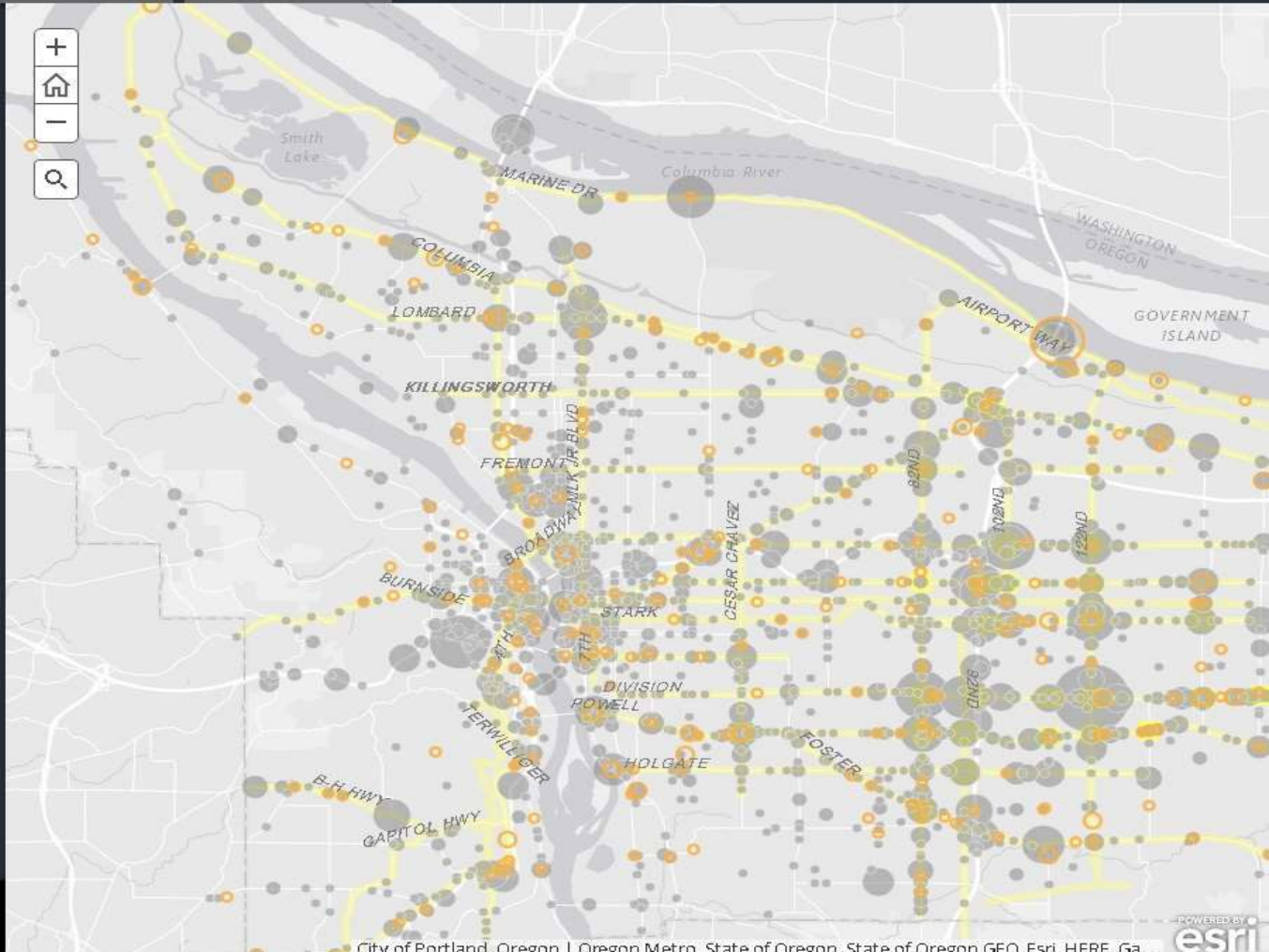


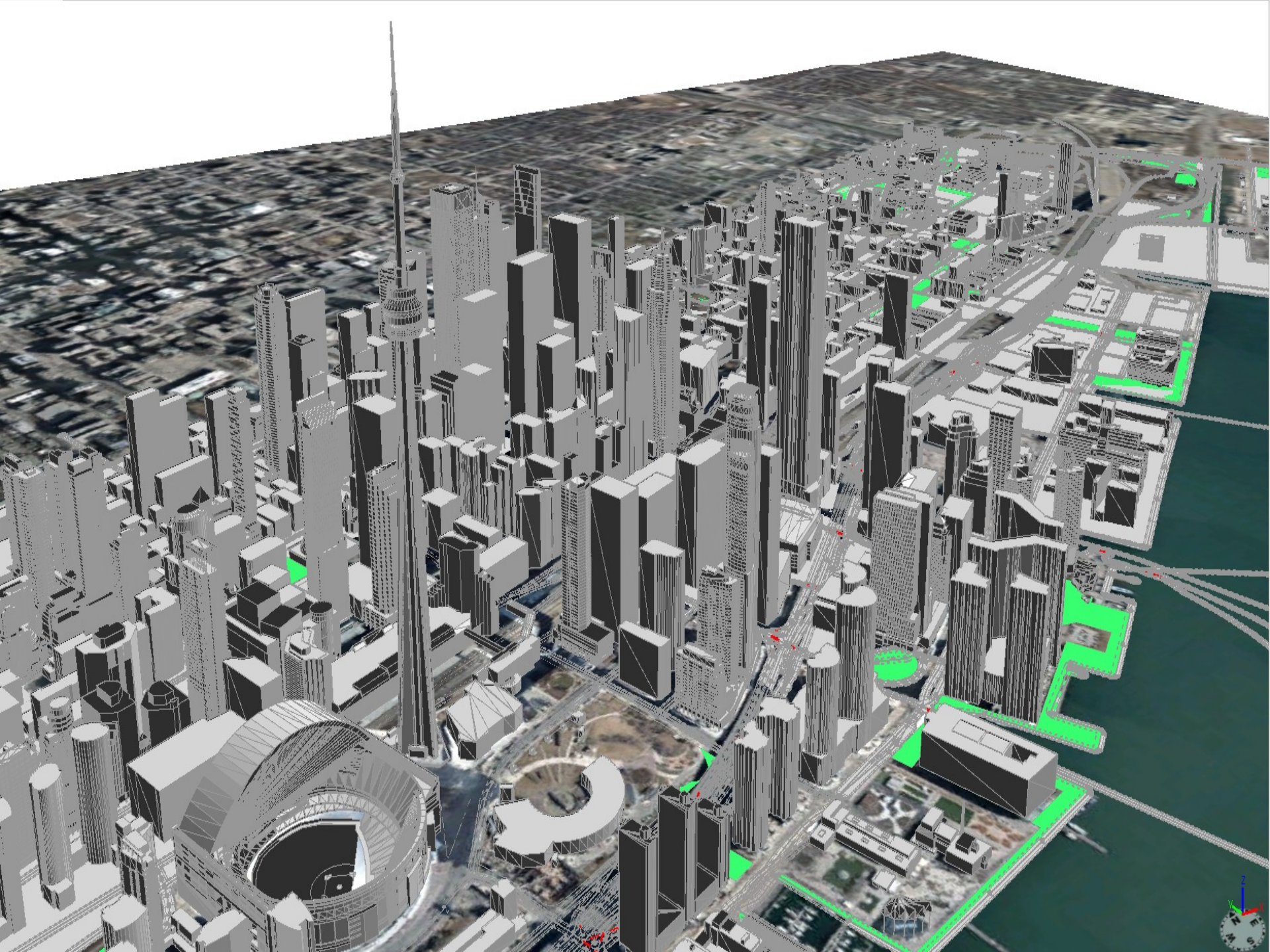
High crash corridors

Ten years of crashes are summarized by mode and intersection on this interactive map. Click on a circle to see the number of fatalities or serious injuries resulting from crashes between 2005-2014. Crashes are coded to the nearest intersection, locations shown on this map may be different than the actual crash location. Difference may be significant on streets with long stretches between intersections, such as on NE Marine Drive.

Learn more about our [Vision Zero](#) effort. You may also be interested in [Metro's Crashmap](#) for the entire Portland metro region.

Sources: map data, Oregon Department of Transportation; chart data,

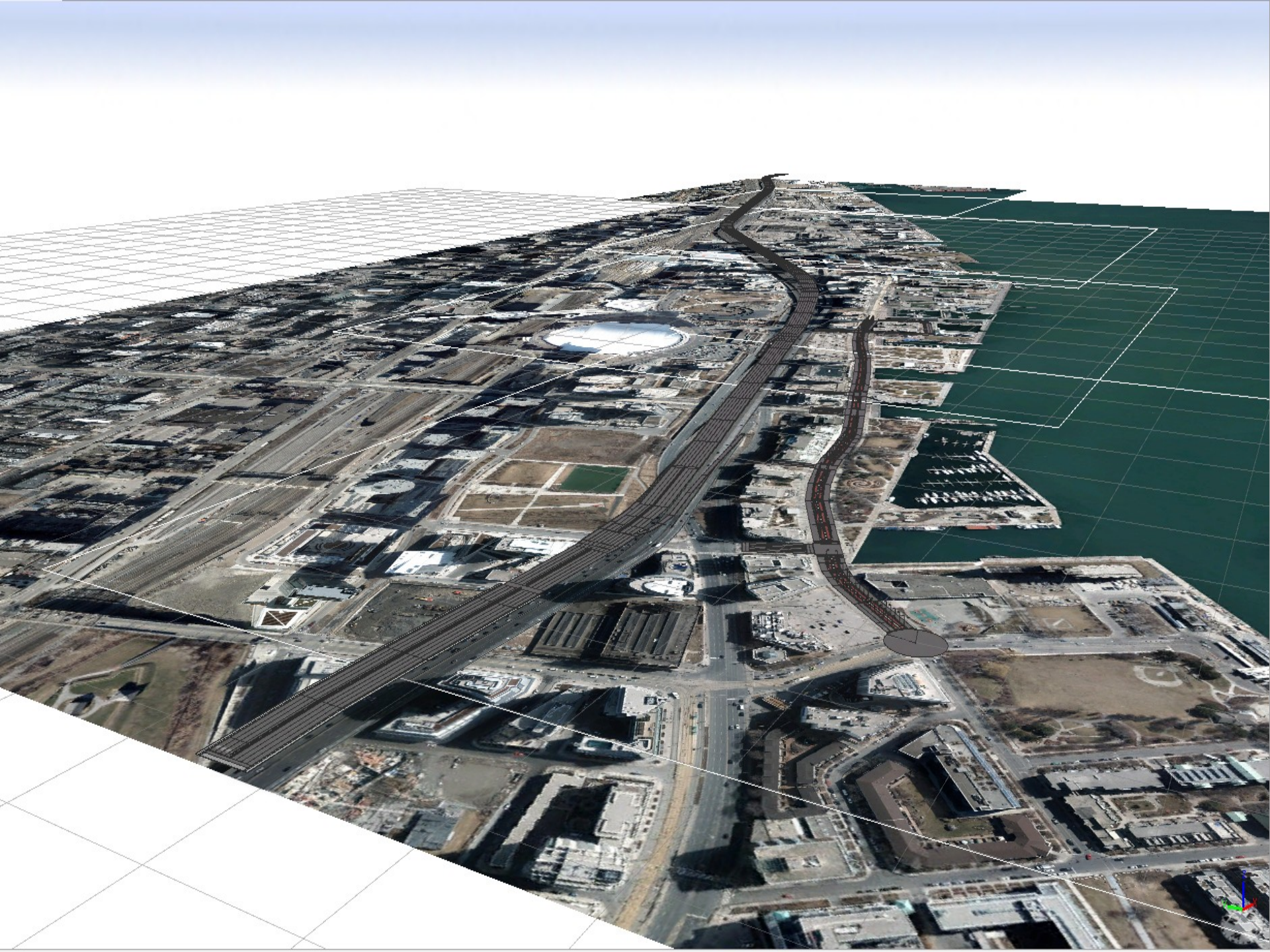


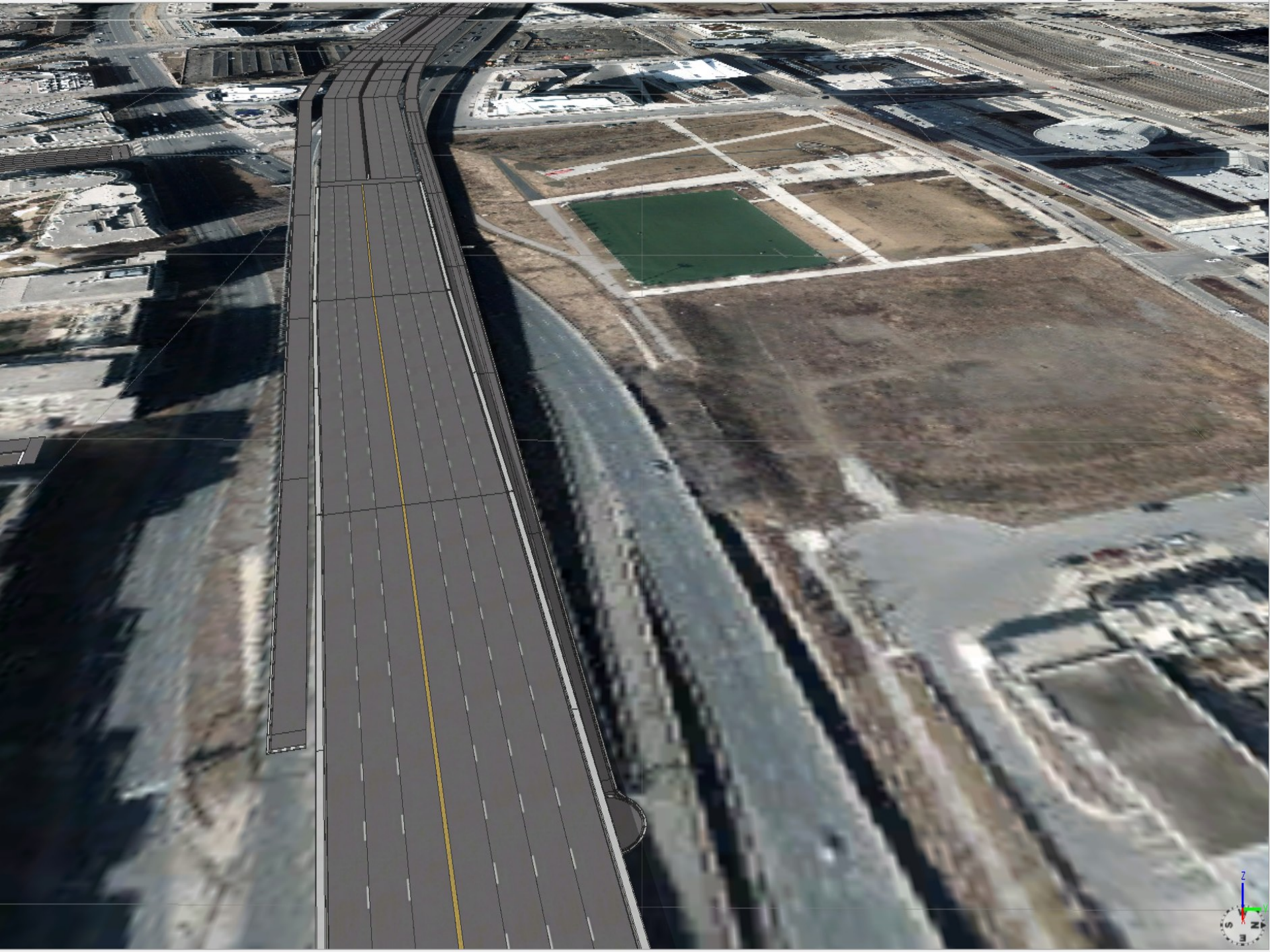


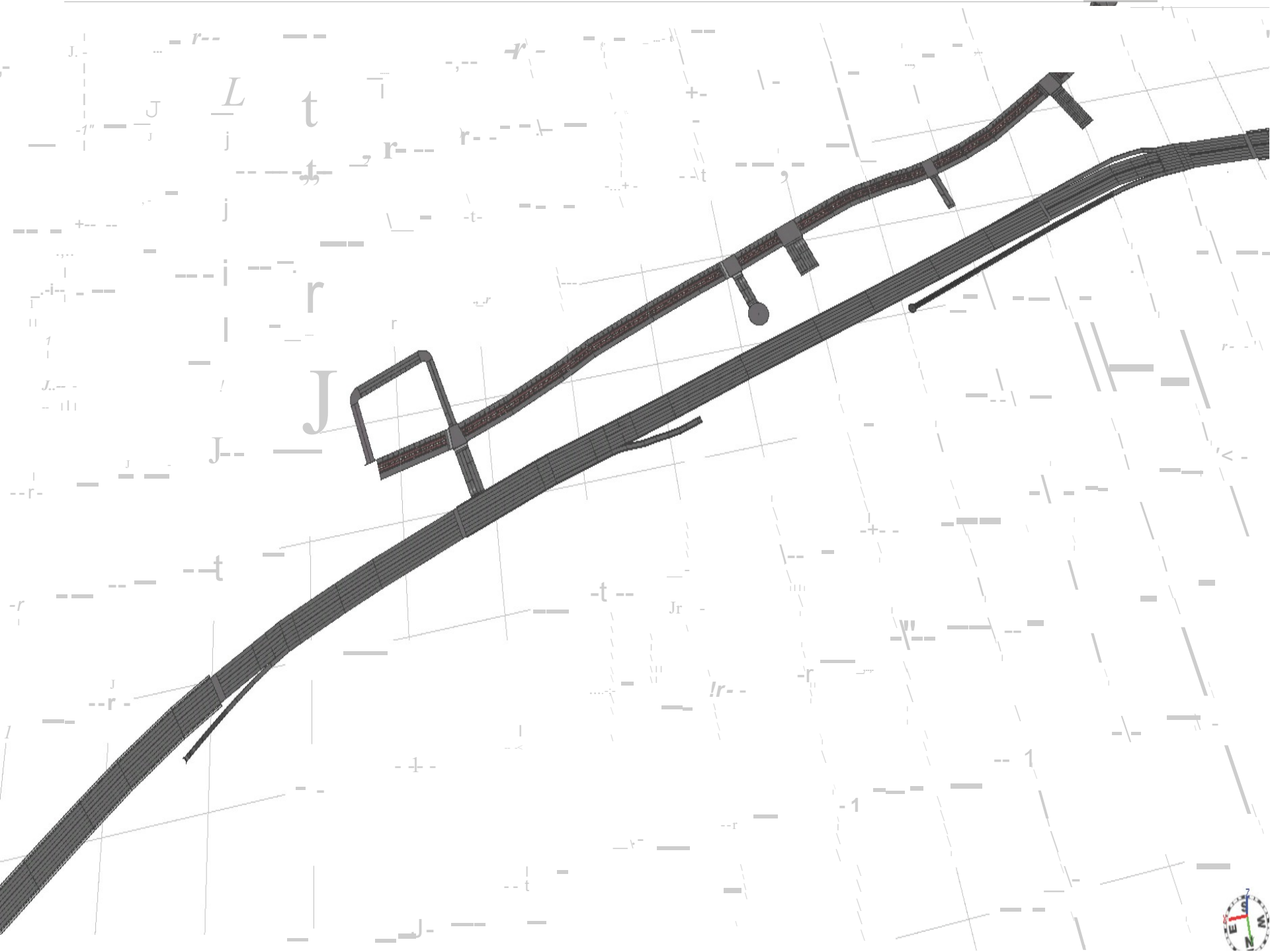




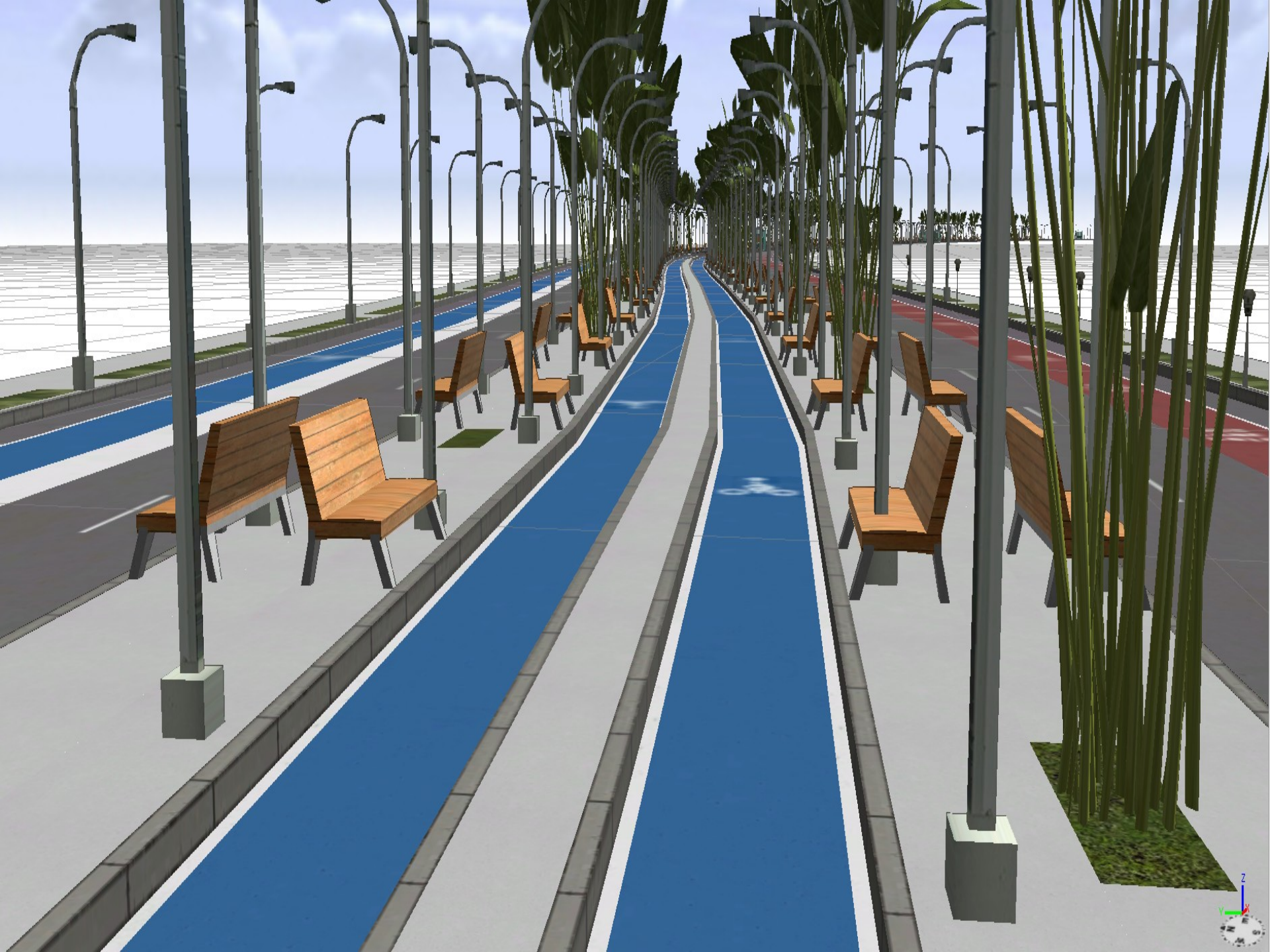




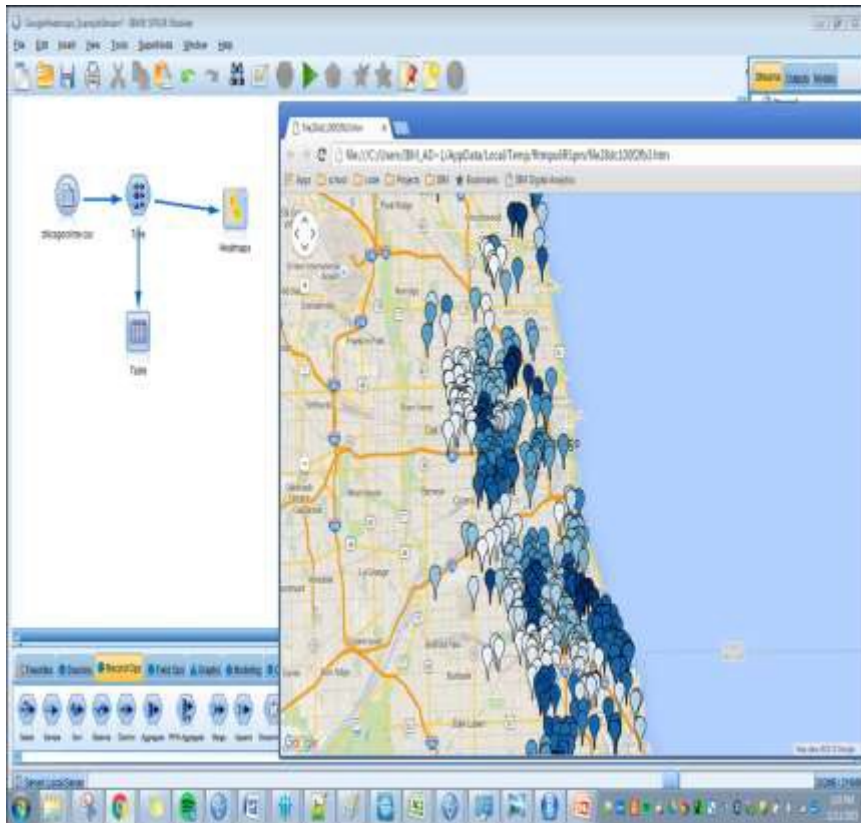








Visualization Tools for Transportation Analytics - IBM



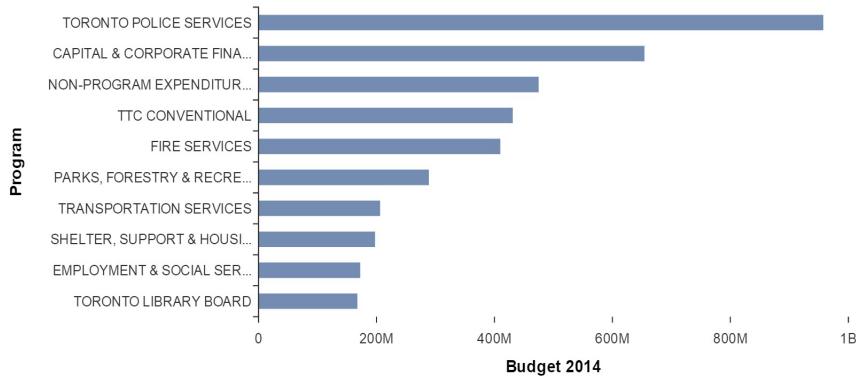
- IBM SPSS Modeler is a predictive analytics platform
- Examples:
 - Traffic Time-series
 - Analysis
 - Demand Forecasting
 - Service Level Prediction

Functionalities

- Data Warehousing
- Data Exploration & Dashboarding
- Cognitive Solutions (Text –Voice Processing)
- Modeling and Prediction

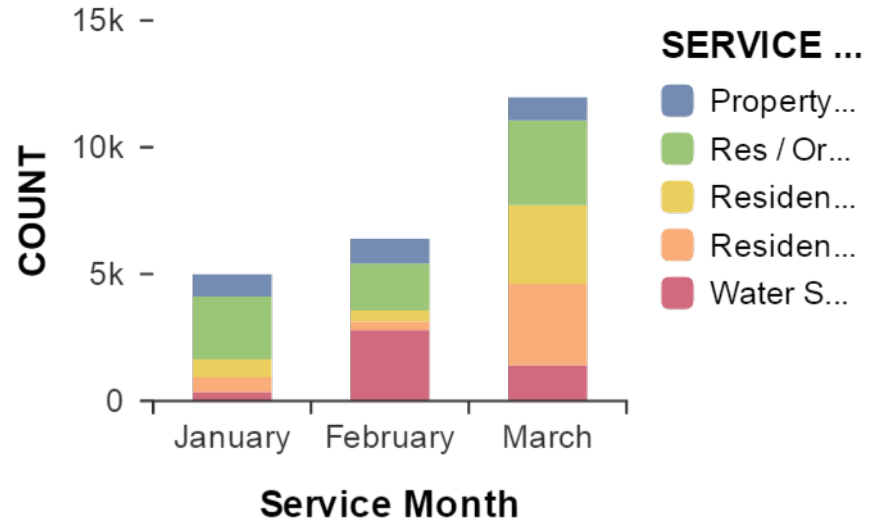
SAP DBV₁

Top 10 Budget 2014 by Program

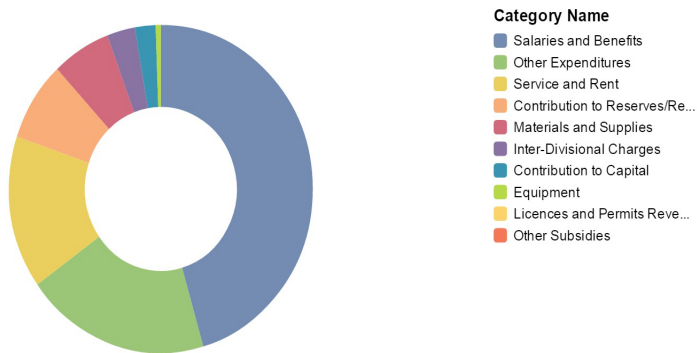


SAP

Service Request Typ...



Top 10 Budget 2014 by Category Name



Service Request Types





Top 10 Vehicle Volume By Street 2013



- Address**
- 696 KENNEDY RD
 - 648 SHEPPARD AVE E
 - 454 DON MILLS RD
 - 1407 WILLIAM R AL...
 - 619 STEELES AVE W
 - 131 YONGE ST
 - 1170 BRIMLEY RD
 - 1191 STEELES AVE E
 - 566 THE QUEENSWAY
 - 1192 STEELES AVE E

EXECUTIVE SUMMARY

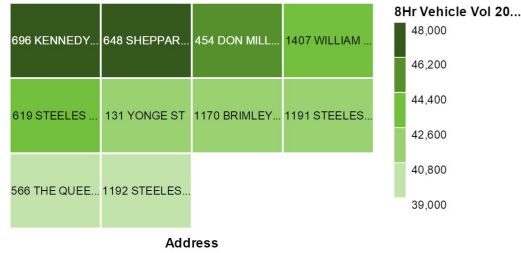
Over 180 languages and dialects are spoken here

Most sustainable large city in Canada

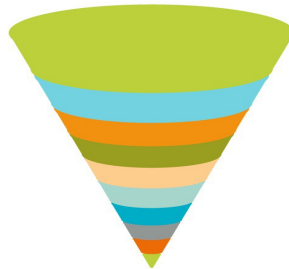
4th most livable city in the world

183 high-rise buildings are under construction – the most in North America

Top 10 8Hr Vehicle Vol 2013 by Address



Top 10 Pedestrian Volume By Street 2013



- Address**
- 277 SPADINA AVE
 - 81 UNIVERSITY A...
 - 279 SPADINA AVE
 - 86 AVENUE RD
 - 321 BLOOR ST W
 - 281 BLOOR ST W
 - 2083 BLOOR ST W
 - 1273 DUNDAS ST W
 - 539 KING ST W
 - 23 CHURCH ST

Top 25 Vehicle Volume By Address



Betaville and Story Facets visualization tools

- *Design Approach*
 - Communication Centered
 - Collaboration- Minded
- *Visual Data/Model Integration*
 - Able to link qualitative data
 - Real-time “what-ifs”
 - Changing/historical data and data ontologies
 - Provenance

Betaville and StoryFacets

- *Visualization Techniques*
 - Interactive Computing
 - Overview + Detail
 - Geospatial Visualization
 - Info vis
 - Comparative Visualization
- *White Boxes*
 - Ontology
 - Models – transparency
 - Provenance - retrievability

Betaville

The screenshot displays a 3D architectural visualization of a city development project named 'Betaville'. The central focus is a large, futuristic building complex with multiple towers and green-roofed sections, rendered in a semi-transparent yellow/gold color. The surrounding environment includes other city buildings, trees, and a body of water in the background.

On the left side, there is a 'new proposal' form with the following fields:

- PROPOSAL TITLE
- PROPOSAL DESCRIPTION
- ADDRESS (optional)
- WEBSITE URL (optional)
- new version of existing design
- [Click on the model you want to update]
- VERSION DESCRIPTION

Below the form is a 'next' button and a progress indicator with five red dots.

On the right side, there is a control panel with the following elements:

- No Title
- Move Speed: 1
- Rotation: 0
- Move North, Move South, Move Up, Move Down, Cancel buttons

In the bottom-left corner, a 'Performance' window displays the following data:

- Frames Per Second: 30
- Triangles in Scene: 349k
- Triangles in Selected: 81k
- ✓ Round FPS ✓ Round Triangle Count

At the bottom of the interface, there is a 'PROPOSALS' and 'VERSIONS' tab system. The 'VERSIONS' tab is active, showing a list of proposals:

Proposal Name	Author	Version
Maglev Station (1)	Bud Griffis	1
Liberty Piers (3)	B-Ville Crew	City made
Liberty Piers Version 2		a (very) mixed-use development
Liberty Piers Version 3		a (very) mixed-use development, with much-needed flora



INFORMATION x

name
Whisman Bikeway

address
Brooklyn Bridge

description
Infrastructure with a trace of play

url
None

Uploaded By: Carl update

StoryFacets

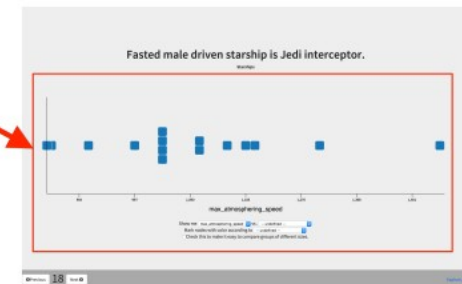
Linked back to trail facet



(a) Trail Facet



(b) Dashboards or Info Graphics Facet



(c) Story Facet

StoryFacets

Story (slideshow) facet - Star Wars character height

Answer #7 Explore Dashboard Story

[← Back to list](#)

Get share link

Answer #7 [Preview](#)

2. People

Among the residents select who is tallest.

3. Markdown

And he is Lama Su from Kamino.

Subtitle

Among the residents select who is tallest.

height

Show me height vs

Mark nodes with color according to

Check this to make it easy to compare groups of different sizes.

A Chart from Trail

Previous 2 Next

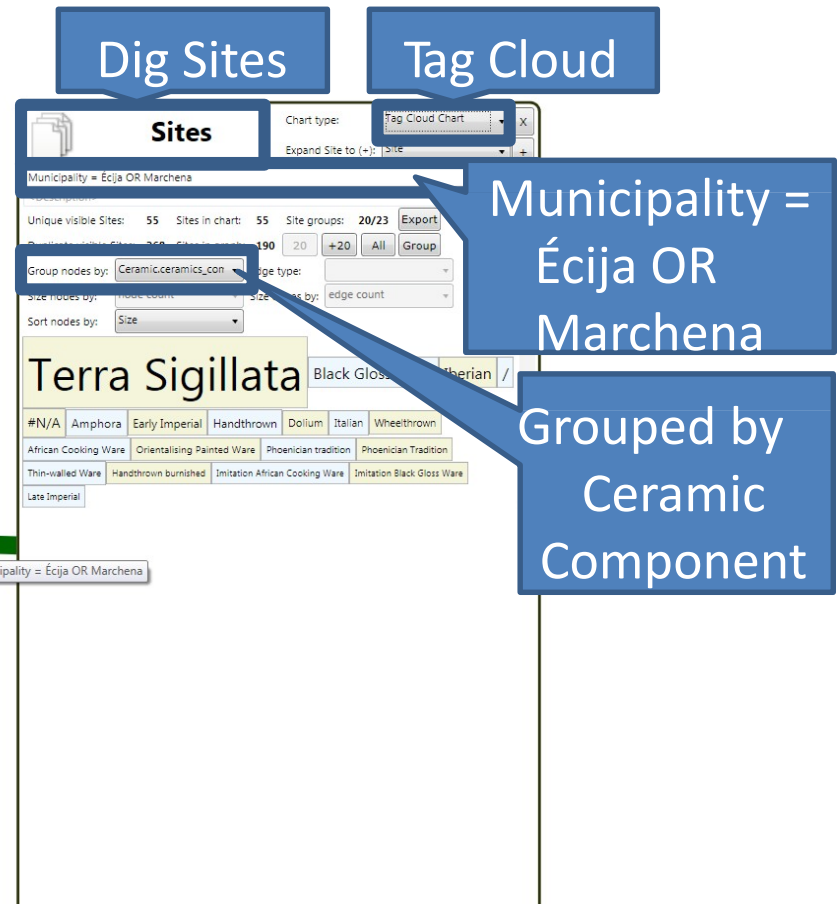
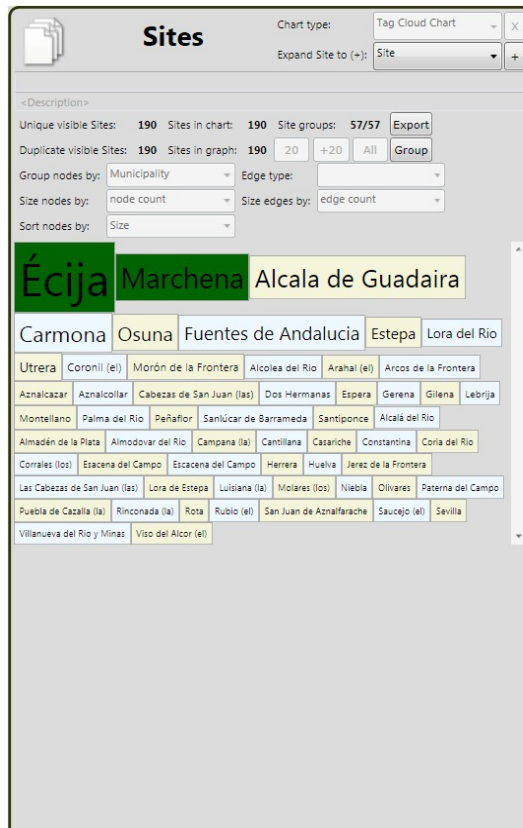
Slideshow Explore

SubTitle: Among the residents sele

Slides Preview

GraphTrail

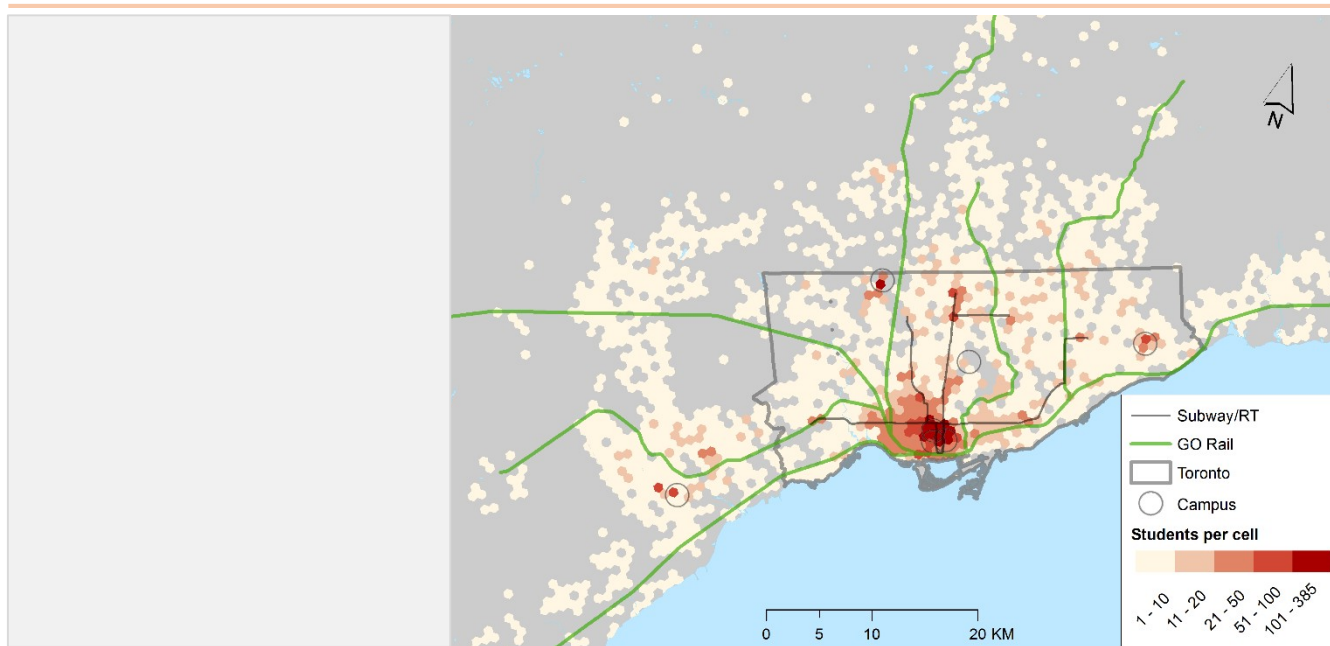
Provenance & chart parameterization



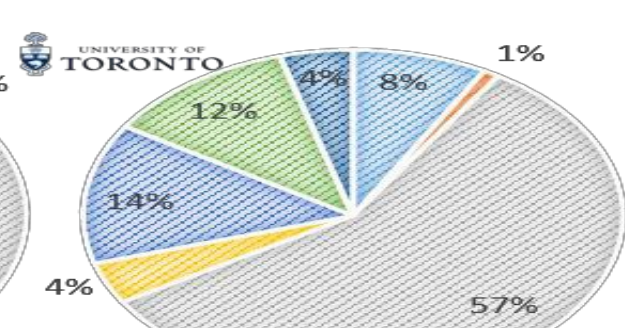
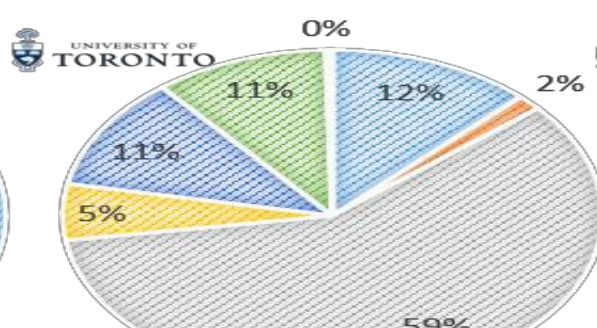
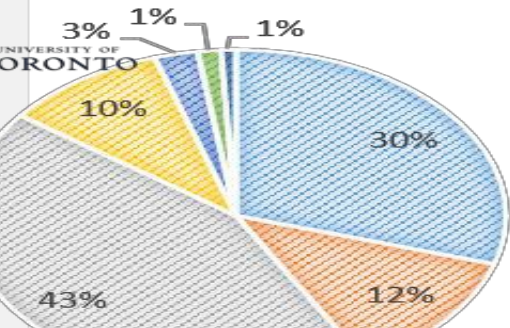
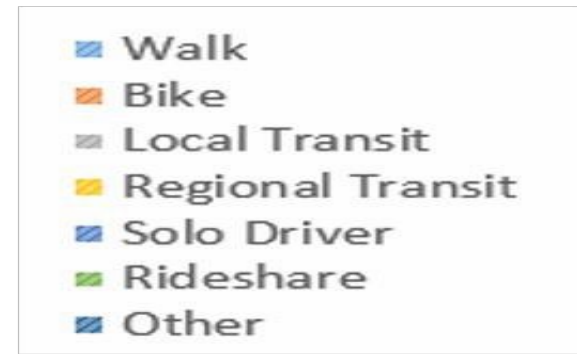
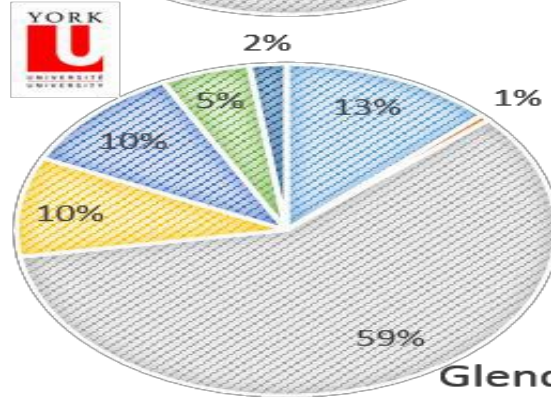
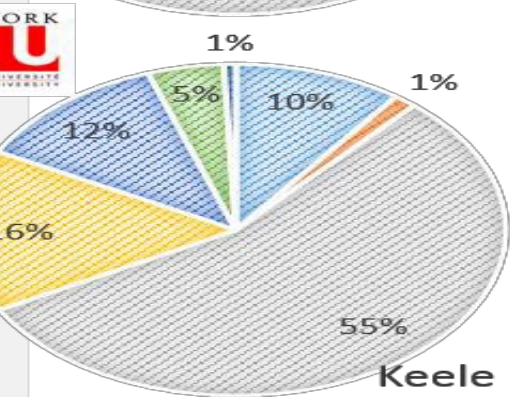
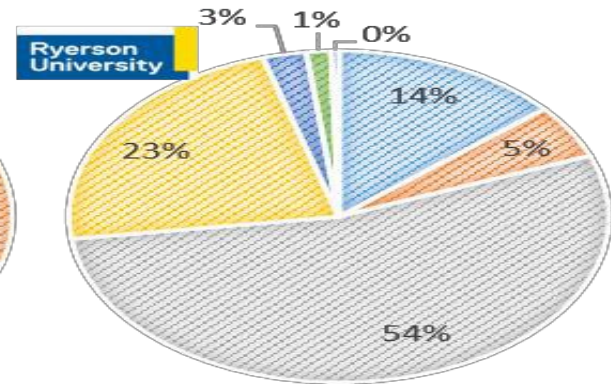
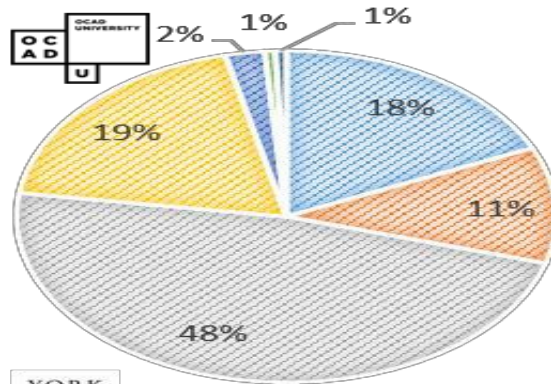
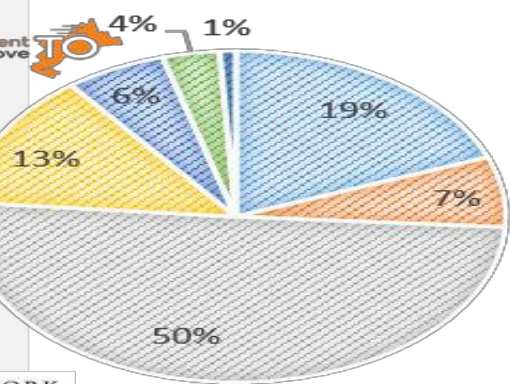
Student MoveTO

- Online single-day travel survey of students, conducted at four major schools in Toronto in the fall of 2015 – 10% response rate
- Survey: factors affecting home location choice; comprehensive scheduling and travel related to work, study, and other daily activities
- Spatial accuracy with anonymization in its published data - home location as centered in specific blocks of the Toronto Transit Survey map, a set of planning "meta-blocks"
- InfoVis and comparative visualization systems

Home Location of Respondents



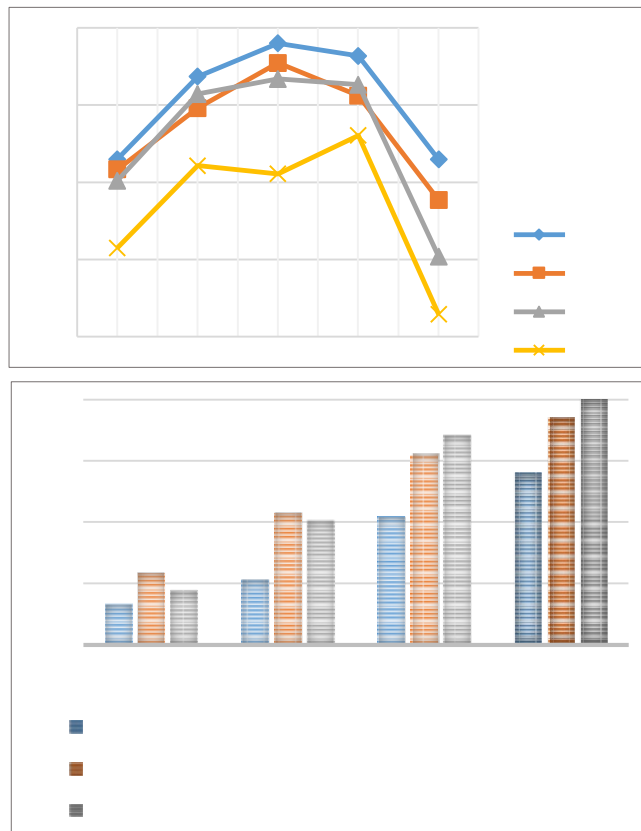
StudentMove TO



Reason for Recent Moves

Cost of housing	24.1%
The decision was out of my control	20.7%
Ability to walk or bike to campus	15.9%
Housing qualities (space, yard, ...)	9.2%
Proximity to public transit	8.1%
Being near friends and family	7.4%
Amenities of neighbourhood (shops, parks, houses, ...)	6.3%
Other	4.4%
Walkability of neighbourhood	2.4%
Crime and safety	1.4%

Relationships commute time and school engagement



- Percentage coming to campus daily by distance of commute
- One way commute and involvement in school: pick courses by commute time, commute discourages coming to campus, commute discourages extracurricular activity

Work/Drivers of Change

PERCENTAGE WHO WORK

Do not work	46%
Work part time (<10 hours per week)	20%
Work part time (11-20 hours per week)	19%
Work part time (21-30 hours per week)	7%
Work 31-40 hours per week	4%
Work > 40 hours per week	3%
Work 31-40 hours per week	4%
Work > 40 hours per week	3%

MODE CHANGE MOTIVATIONS

Change in household location	59%
Improvements to transit	26%
Decreased transit costs	21%
Increased transit costs	20%
Worse congestion	15%
Decreased parking costs	15%
Nothing, Will not change	14%
Improved bike lanes	9%
To improve health	7%
Environmental concerns	6%
Roadwork disruptions	6%
Improved pedestrian environment	4%
Increased parking costs	3%
Added bike storage	3%



4/19/2016

OCAD_2D

Layer name
OCAD_Postal

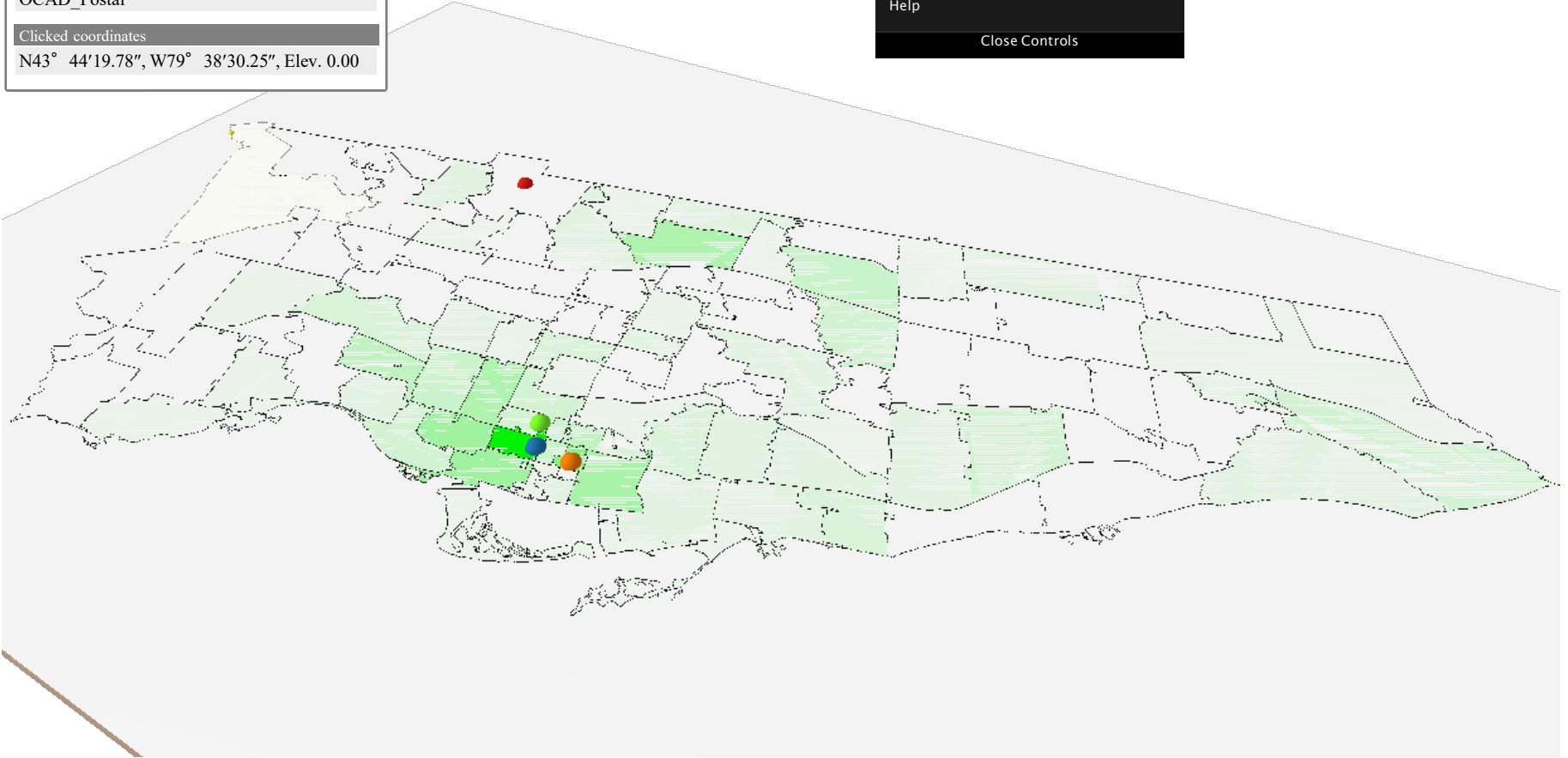
Clicked coordinates
N43° 44'19.78", W79° 38'30.25", Elev. 0.00

Layers

Custom Plane

Help

Close Controls

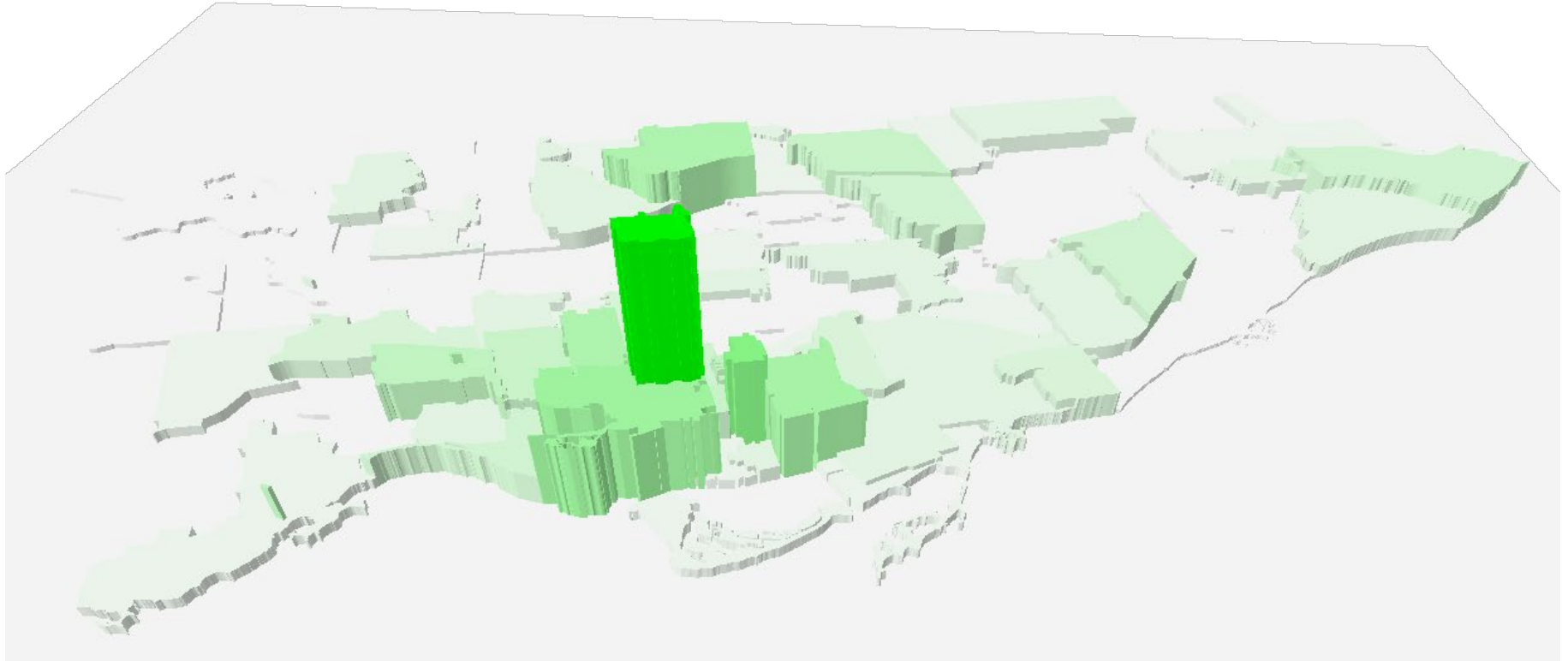




4/19/2016

OCAD_3D

- Layers
- Custom Plane
- Help
- Close Controls



Health Care



- Taking Ontario Mobile Report, 2013
- Management of e-health records
- Access to out of region expertise
- Virtual Surgery and Intervention support
- Distribution of Online and Mobile Solutions across LInS



Health Care



- Emergency Service Coordination, Clinic and Emergency Waitlists
- Just in Time services to elderly in home – appropriate teams
- Pandemic management
- Monitoring of Adherence and Interventions – public health –



Conclusions

- All of the systems shown work with Big Data
- Citizen-hackathon delivered approaches to urban planning, critique and engagement
- Artists' approaches to making the city visible and livable
- Urban transportation planning – systems based – using resources of Smart City
- Big Data analytics for health
- Opportunity to bring together levels of planning and integration

Conclusions – Big Data - Smart City Visualization

- Citizen-focused
- Collaborate
- Data Governance and Analysis
- Connect
- Co-create
- Communicate