Data Visualization and Uncertainty

The iCity case study

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How can data visualization address uncertainty?

1. Context and rationale for the socio-technical system to be a supportive resource to mitigate uncertainty

2. iCity project as a case study example

   - User centred process to develop a visualization taxonomy

   - Application and prototype testing

Context and Rationale

The human mind is incredibly averse to uncertainty and ambiguity, In order to address the uncertainty and increasing complexity of urban life and navigate the social and experiential aspects of urban systems individuals have integrated social technological systems into their daily routines.

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Image: Saul Gravy/Getty, goo.gl/CVEKZL

These technologies, such as mobile phones and social media, interact with or contain sensors, WiFi and blue tooth networks, receiving and transmitting significant amounts of data which will only compound in the Digital Future.

These data, which require analysis and provenance tell stories about cities.

Image: Saul Gravy/Getty, goo.gl/CVEKZL

"We are witnessing a rapidly evolving landscape in the Business Intelligence market, and interesting innovations in areas such as behavioral and predictive analytics.

Overall, we can say that 'Big Data' is in the midst of a transition to 'Complex Data,' and that means **visualization will play an increasingly key role in transforming all this information into actionable insights**."

Tiago Veloso, from visualoop

Tiago Veloso (https://twitter.com/TSSVeloso) from Visualoop (http://visualoop.com/)

Conceptualizing smart cities

The **unprecedented rate of urban growth** creates an urgency to finding smarter ways to manage the accompanying challenges.

Recent practices to make cities better for living have become successful cases for **new city development strategies**.

Conceptualizing Smart City with Dimensions of Technology, People, and Institutions, Taewoo Nam & Theresa A. Pardo Center for Technology in Government, University at Albany, State University of New York, U.S., {tnam,tpardo}@ctg.albany.edu

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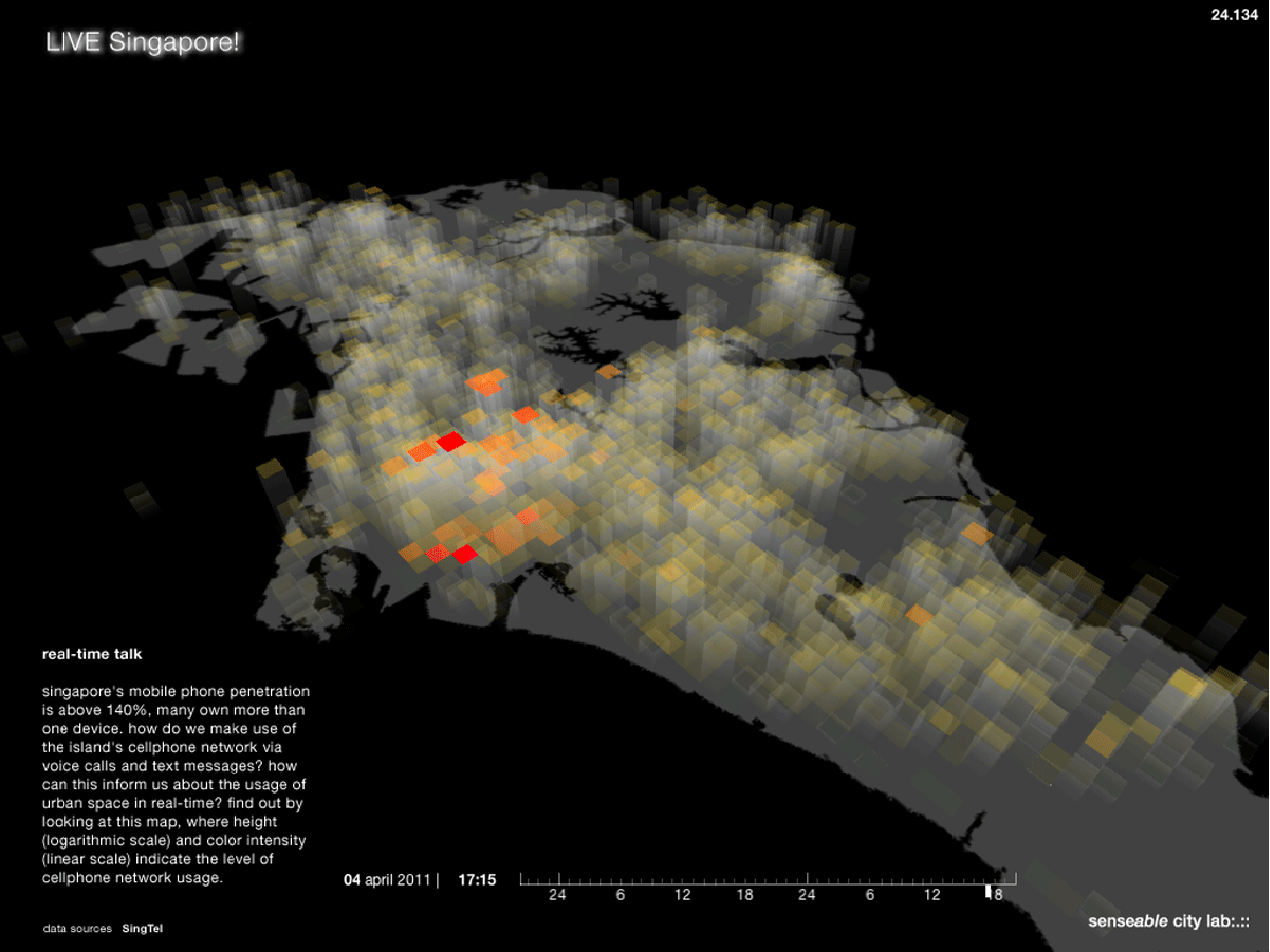
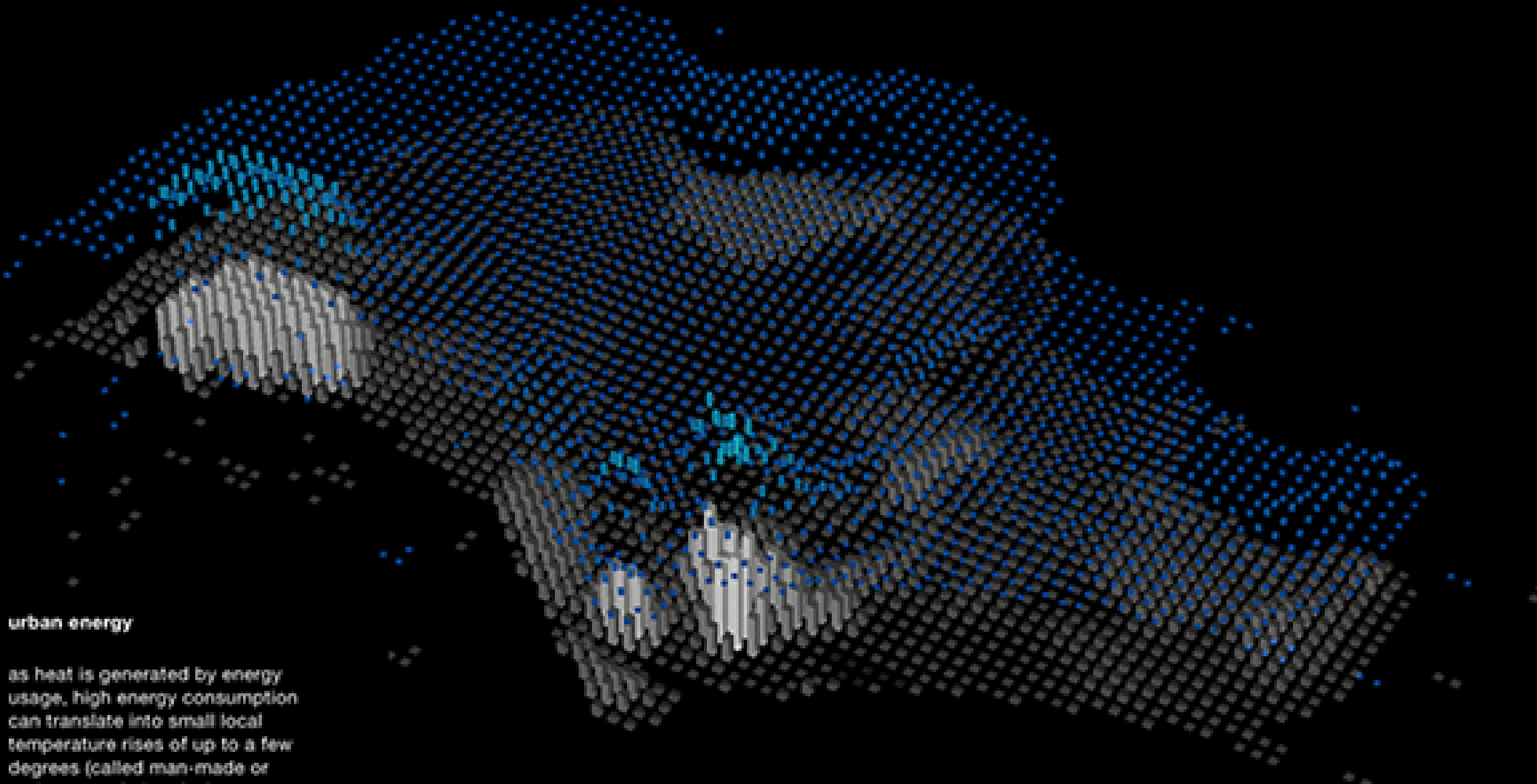
Smart City Project

LIVE SINGAPORE


24.134
LIVE Singapore!
real-time talk
singapore's mobile phone penetration is above 140%, many own more than one device. how do we make use of the island's cellphone network via voice calls and text messages? how can this inform us about the usage of urban space in real-time? find out by looking at this map, where height (logarithmic scale) and color intensity (linear scale) indicate the level of cellphone network usage.
04 april 2011 | 17:15
24 6 12 18 24 6 12 18
data sources SingTel
senseable city lab:.::

LIVE Singapore!



urban energy

as heat is generated by energy usage, high energy consumption can translate into small local temperature rises of up to a few degrees (called man-made or anthropogenic heating). combining data on the energy consumption of the city's different zones with the wind speed, local temperature rise can be estimated. a potential addition of measured urban temperatures will provide the basis for a future city condition monitoring program.

data sources **SP Services | NUS Dept. of Geography**

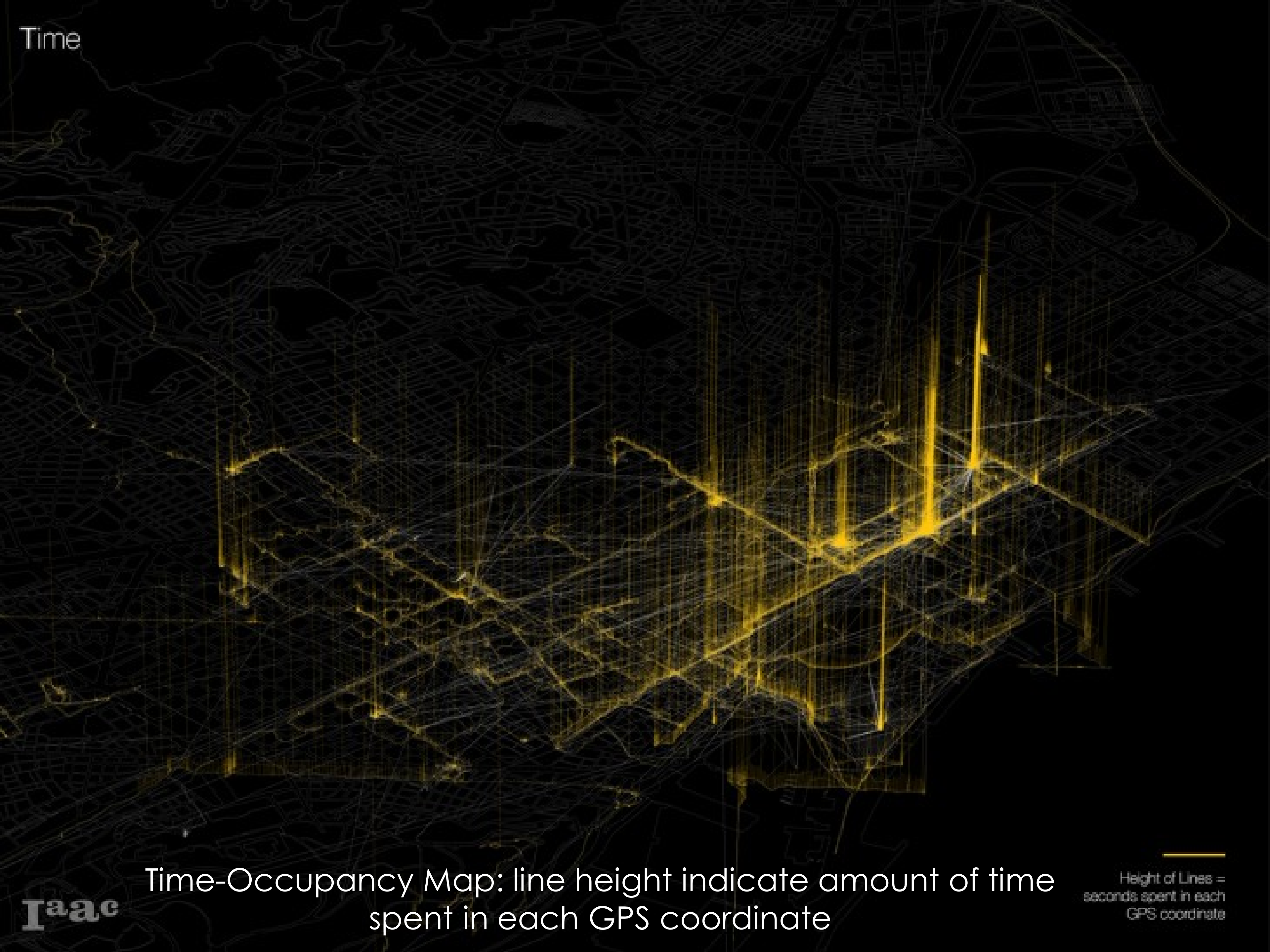
senseable city lab:.::

Smart City Project

BARCELONA

Occupancy Map: line intensity and height indicate occupational patterns

Time



Time-Occupancy Map: line height indicate amount of time spent in each GPS coordinate

Iaac

iCity as a Case Study

iCity is a collaboration between *academic researchers, industry partners, city transportation and planning departments in Toronto* to set out conditions for an interactive interface as a democratic resource for individuals and groups to highlight their needs /wants /values, and participate in strategic planning opportunities.

Image Source: goo.gl/F1TAyx

The iCity urban transport project focuses on the development of data analytics transportation and transit planning tools

Image: iCity Visualization, ESRI cityengine, Michael Carnevalle

At iCity we develop decision support tools combining social media and mobile data with GIS, demographic, socio-economic and transit data

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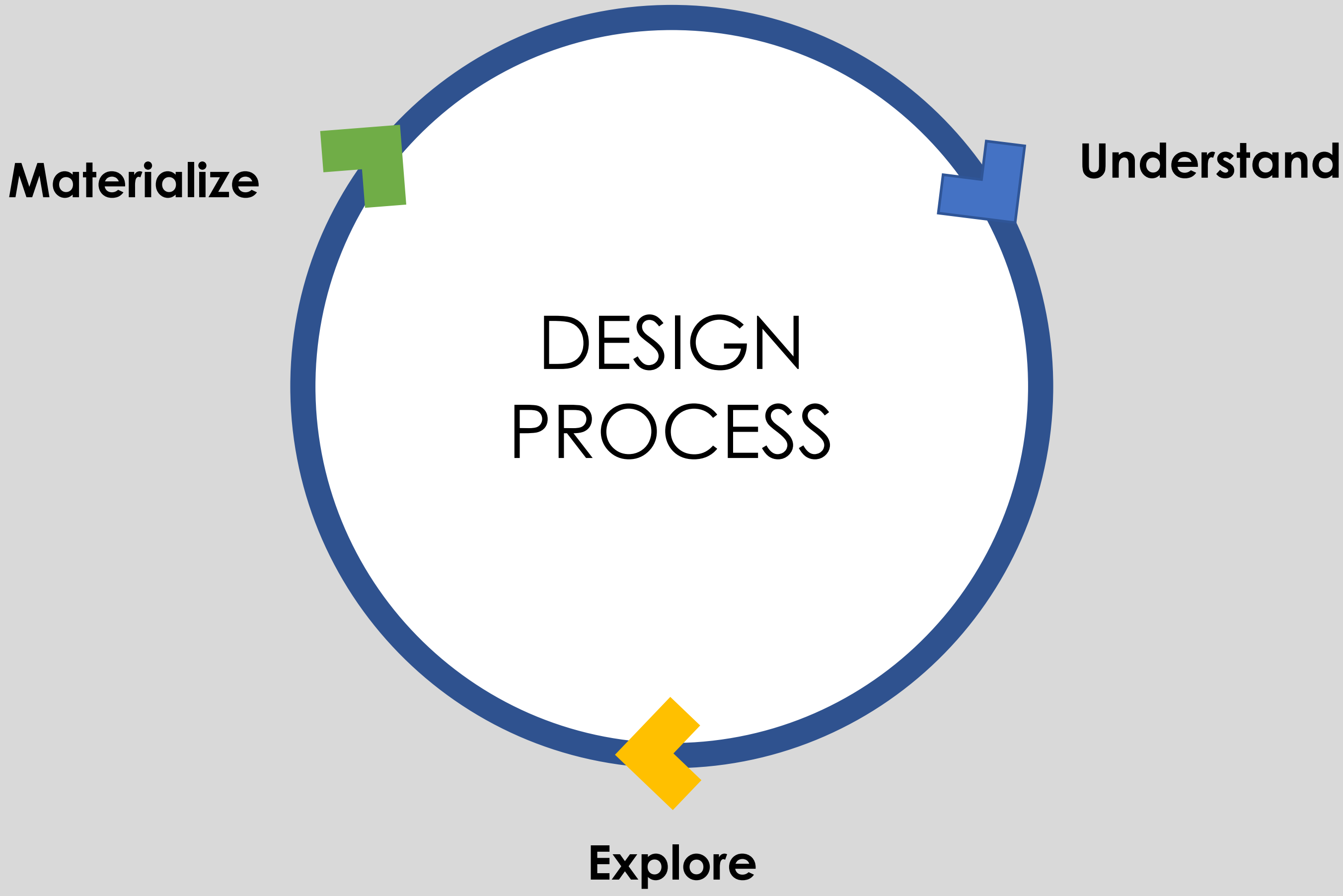
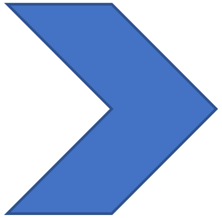
Image: iCity Visualization; ***ESRI cityengine, Betaville***, Marcus Gordon , Carnevalle, Manpreet Juneja



The design process adopted to study comparative methodologies and prototype frameworks for visualization interface.

iCity approach & process



Understand

- Literature Review
- Comparative Methodology in Urban Transportation
- Expert Interviews

Image: Design Process, iCity process phases, Manpreet Juneja

Taxonomy

"A systematic arrangement of objects or concepts showing the relations between them especially one including a hierarchical arrangement of types"
(Webster Online Dictionary, 2006.)

Eg: Library, arrangement of books

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Image: Design Process, iCity process phases, Manpreet Juneja

Key Findings

***Literature Review:** Key elements of Taxonnomy in visualizations*

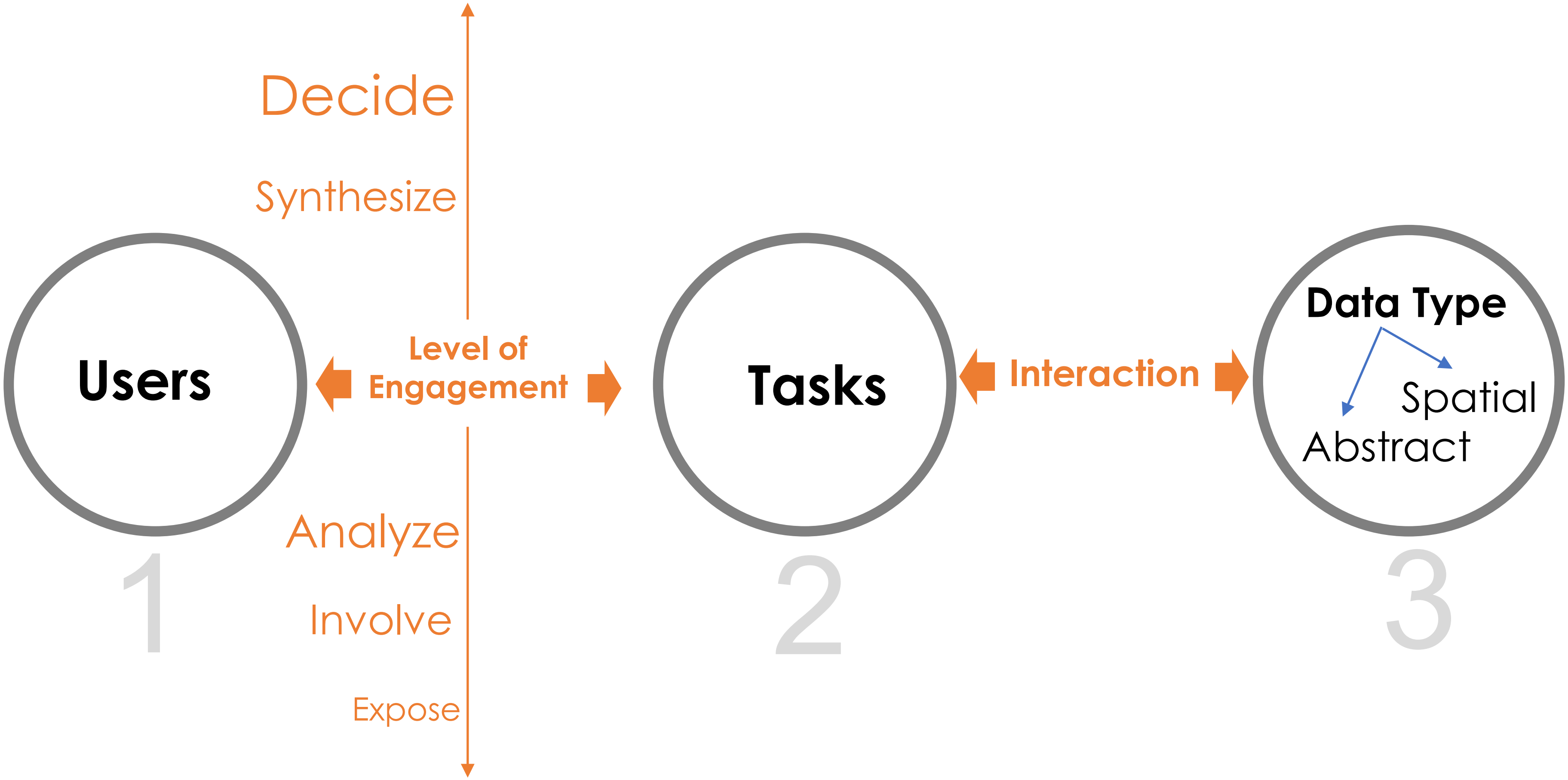

Image: Design Process, iCity process phases, Manpreet Juneja

Key Findings

Comparative Methodology: *A survey of landscape to understand the types of software that exist and the functions already being served.*

Software Application Categories: *Use Domains*

User Stories, Narratives
Navigation
Route Mapping
User Generated Data
Social Media Use

Transportation
Traffic Movement
Parking Management

Urban Design: Built Environment
Neighborhood Planning
Complete Streets

Data Analysis
Intelligent Predictive Analysis
Simulation

Land Use
Agent-based
Micro-simulation

Entertainment & Games
Interactive & Location Based Games
Mixed Reality

Infrastructure Management
Signal & Transit Operations
Sustainability
Resilient Cities

Mapping
Cartography
Geo-Visualization

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Image: Comparative Methodology, iCity process phases, Manpreet Juneja, Marcus Gordon, Jeremy Bowes

Taxonomy Sketch showing essentials aspects of visualizations

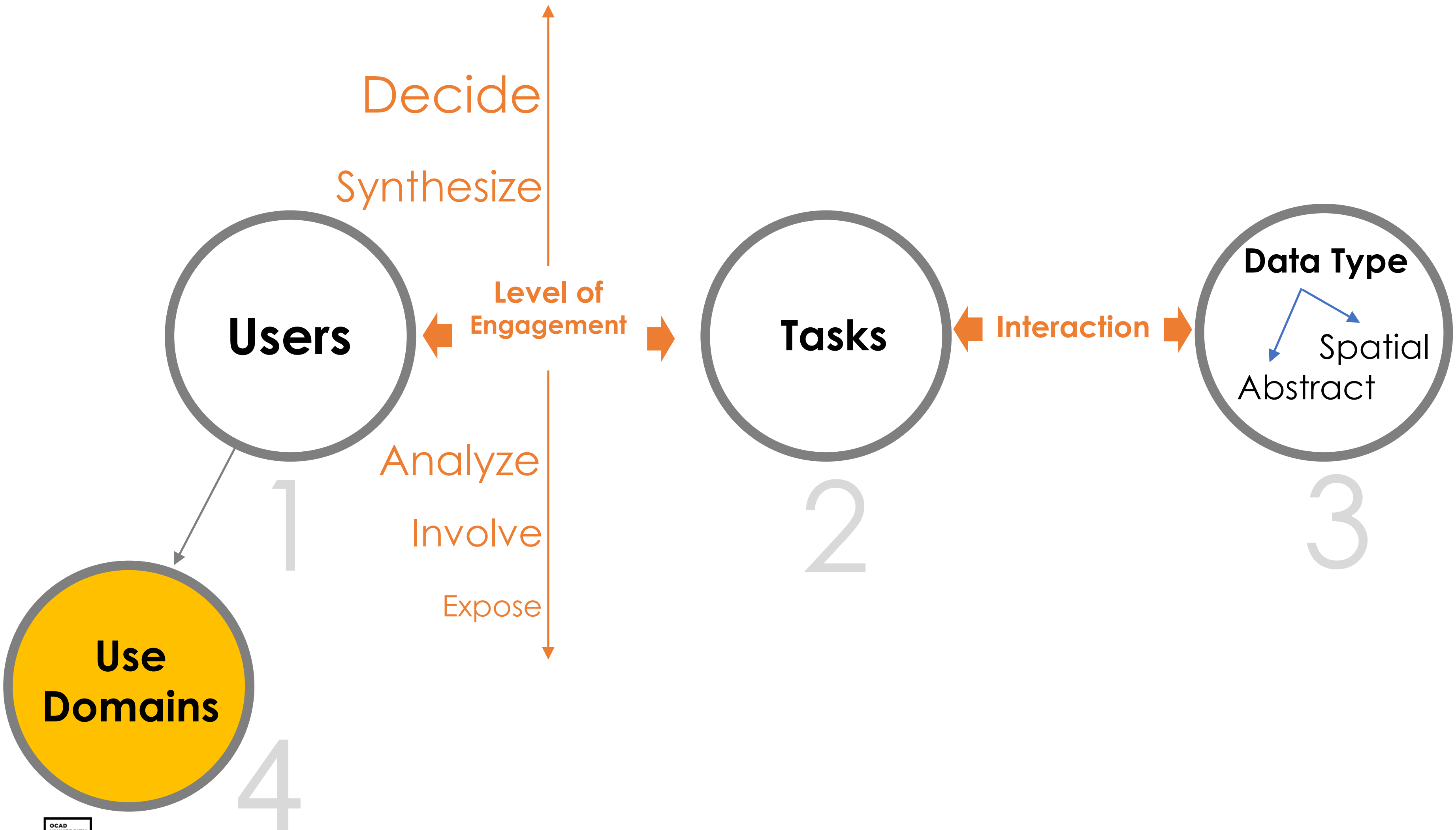


Image: Design Process, iCity process phases, Manpreet Juneja

iCity approach & process

Explore

- Use Case Survey
- Use Case Mapping
- Design Charrette, Priority mapping

Use Case survey

User Type
Gender, Age, Nationality, Occupation
Application Scenario
Description of Tasks
Preconditions
Technology
Software, Environments and Frameworks
Assets
Formats, Functions
Task interaction
How are you using this software/ tool?
Data Visualization
What is the visualization functionality of this software/ tool?
Improvements
How could the software/ tool be changed to support the required tasks?

URBAN INFORMATICS USE CASE PROFILE

Case Number: C3
Date: January 30th, 2017

User Type
Gender: Male **Age:** 56 **Nationality:** Canadian **Occupation:** Architectural technician

Laz is a senior architectural technician working for city planning. His area of expertise is reviewing rezoning applications and new development projects.

Application Scenario

Laz is processing an application for a building rezoning in the new West Don neighbourhood. The applicants have not provided any parking statistical information, and Laz needs to ascertain whether the existing street, and lot spaces will be overburdened by new users if the project proceeds. He must perform Quantitative Data Exploration and Analysis of existing parking resources, land use, and demographics, to evaluate current and proposed parking space inventory against policy/ regulations, as documented in the city's geodata/survey and 3D model resources.

He needs to provide two documents of his findings:
- an explanatory presentation (slide show) for an upcoming community meeting;
- a formal record of the application's parking implications, context, applicable regulations
- recommended ruling based on the above items

Description of Tasks

Exploration of geodata & 3D model of existing conditions,
record of parking inventory in defined area,
calculation of requirements with/without proposed changes,
export of tabular data and graphics,
preparation of formal document and slide presentation for ruling recommendation decision support/justification/communication with decision-makers and stakeholders

Preconditions
Knowledge of local study area, accessibility to platform, understanding of interface & functionality, availability of peak parking data,both on--street and private etc.

Technology
Software ArcGIS, CityEngine, Insights
Environments & Frameworks html5, webGL, Javascript

Assets
Formats online SHP, CSV, XLS, JSON, dwg, dmg files
Functions 3d Bar charts, Geo--Data, Bar chart, interactive digital maps with on/off information layer switching, call--out boxes

Task Interaction **How are you using this software / tool?**
Orbit, Walk/ fly--through, pan, scroll, zoom, select, annotate, measure, (annotate measurement?), zooming inset, scrolling, panning, compare, microsimulation etc.

Data Visualization **What is the visualization functionality of this software / tool?**
Uses technological interface to visualize street segment, with displayed data of parking information per location as statistical comparison.
Capture of generated scenario data in a form for presentation. Access of demographic community data to project potential local patrons to future establishments. Interface to select, analysis, and prepare a visual summary of queried data on parking locations.

Improvements **How could the software / tool be changed to support the required tasks?**
Real--time 3D infographics superimposed, 2D map, highlighted statistical charts, prep of visual narrative

Image: Use Case Surveys, iCity process phases, Manpreet Juneja, Carl Skelton, Jeremy Bowes

Use Case Mapping Template

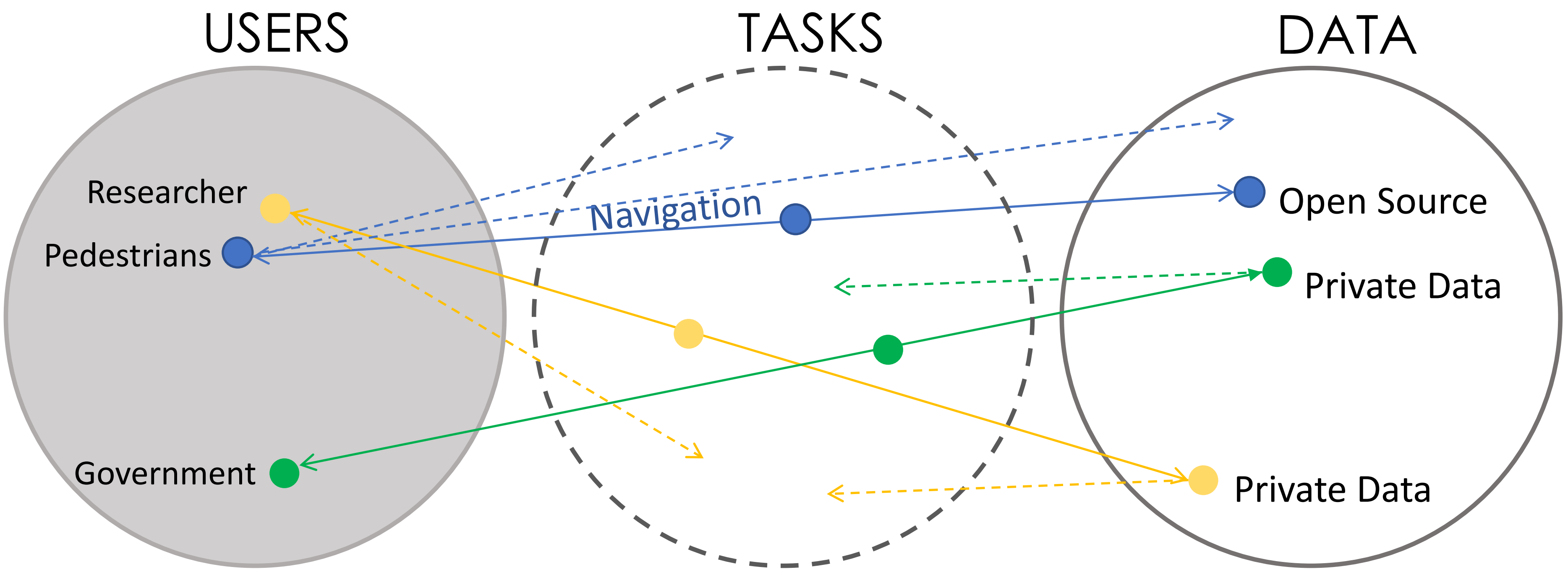


Image: Use Case Mapping - Users, Tasks and Data, Manpreet Juneja, iCity Team

Use Case Mapping

Selected Integrated Use Domain Example

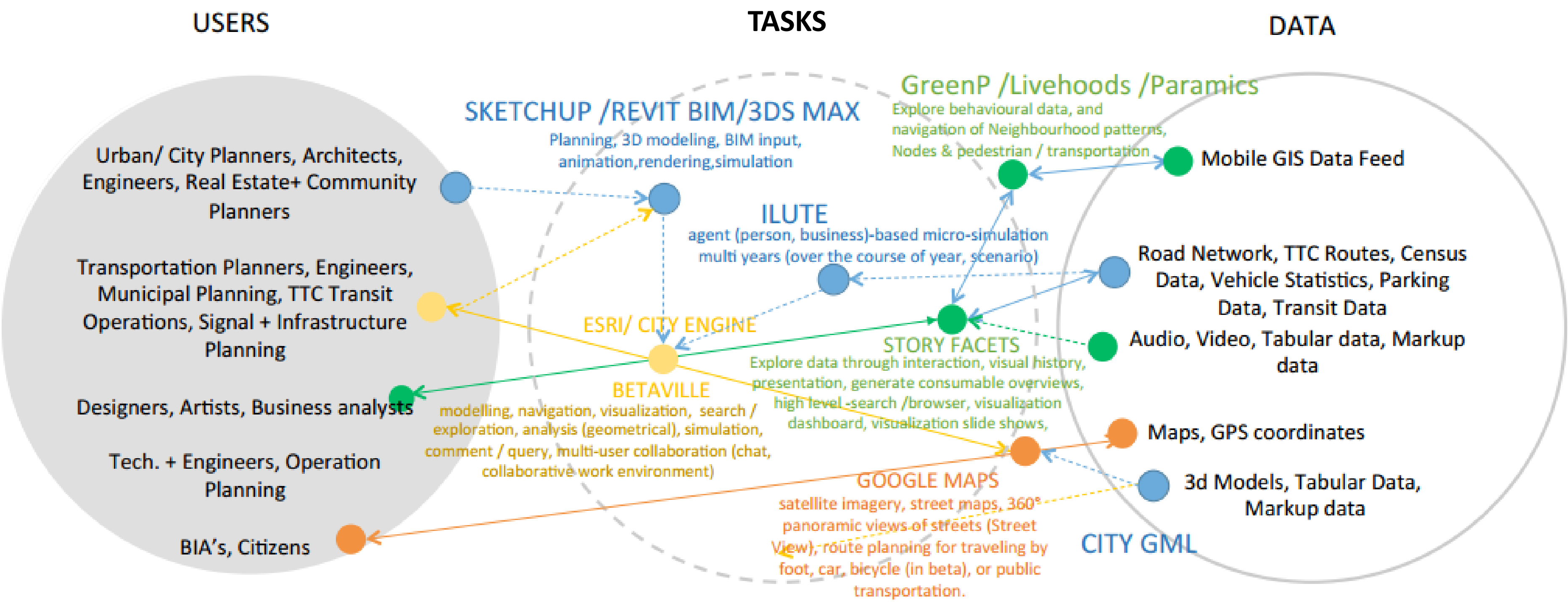
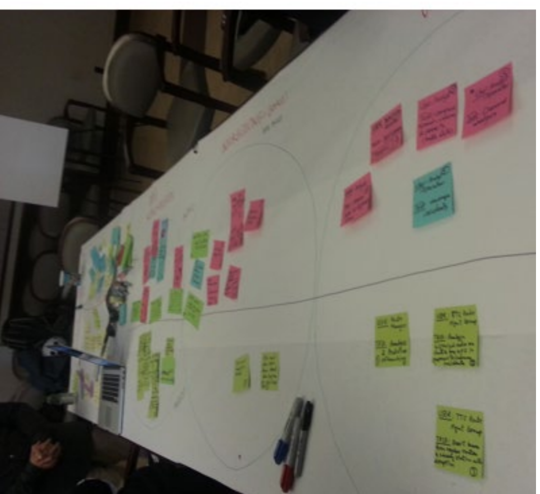
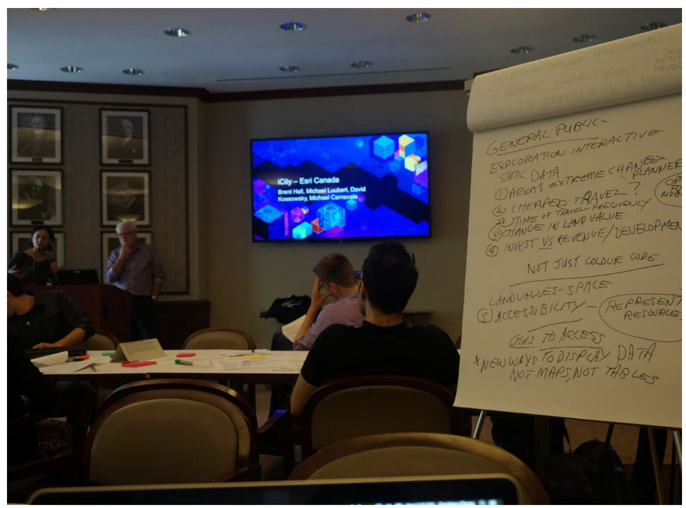


Image: Use Case Mapping, iCity process phases, Manpreet Juneja, Jeremy Bowes

Design Charrette

Test Taxonomy Sketch
Establish priorities to build interface prototypes





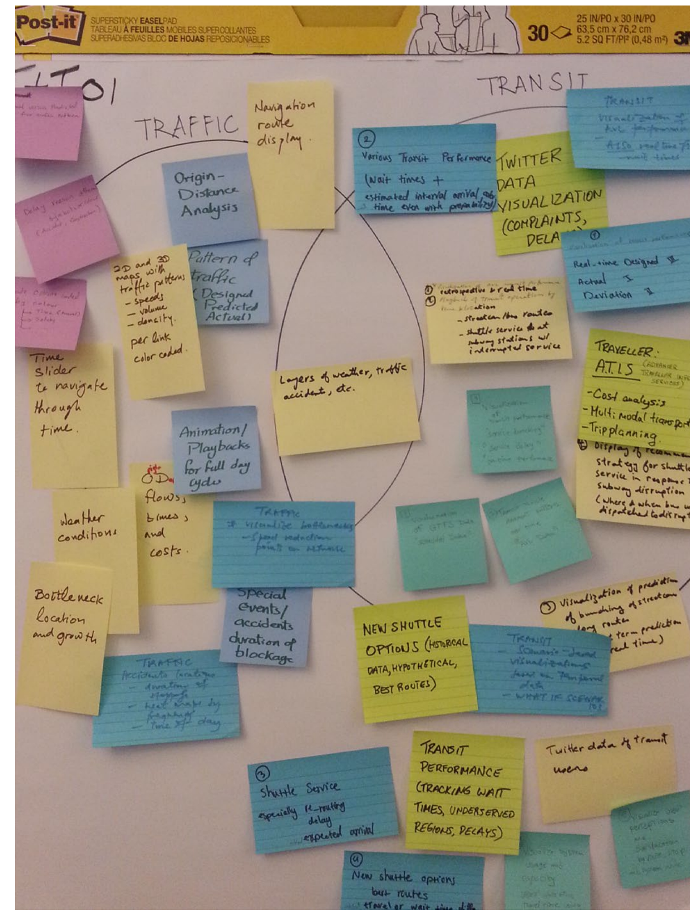


Image: Charrette Images, iCity process phases, iCity Team

iCity approach & process

Materialize

- User-Centred Taxonomy for Urban Transportation Applications
- Applications and Visualization Prototypes

User centred Taxonomy for Urban Transportation Applications

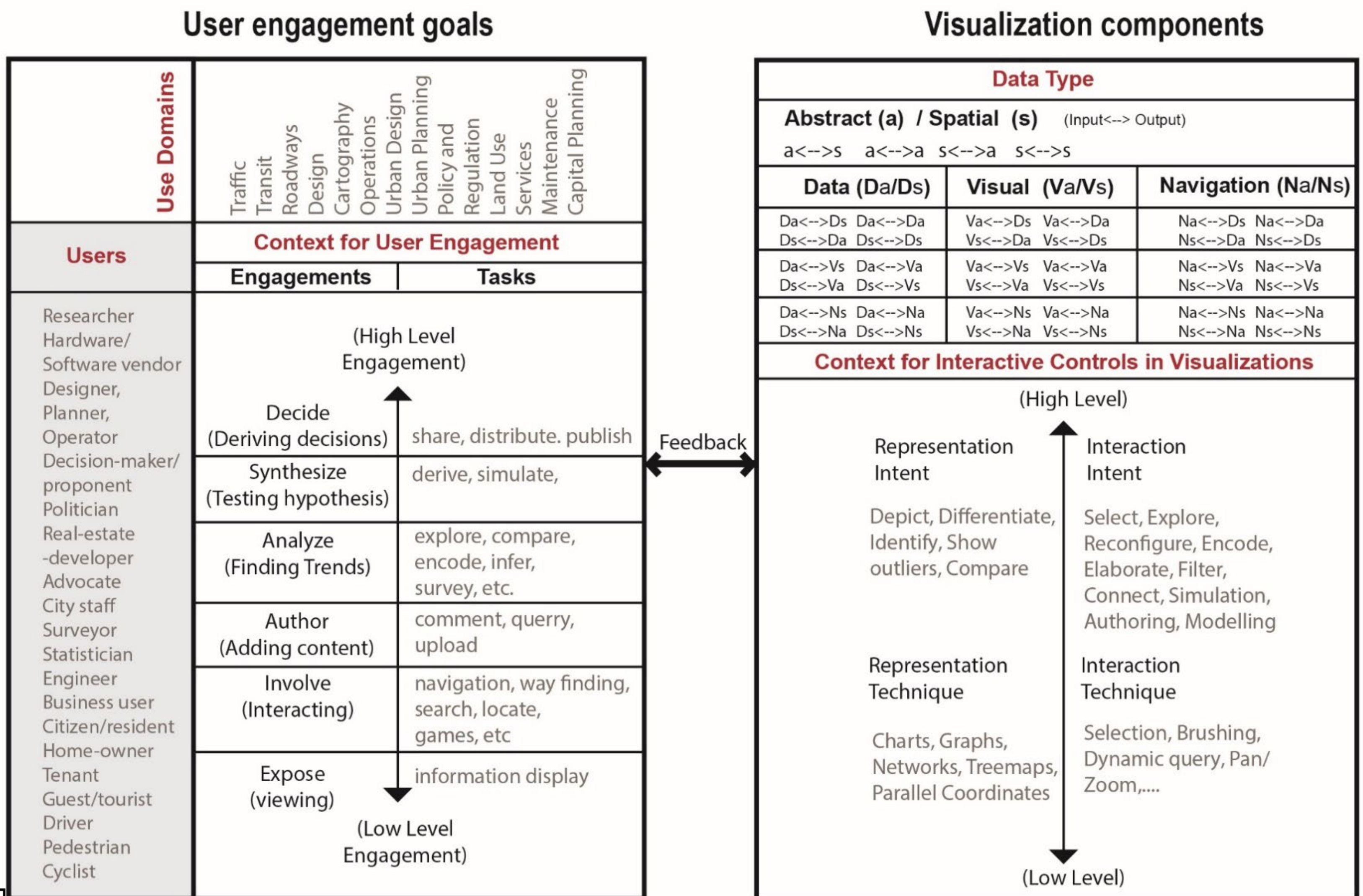
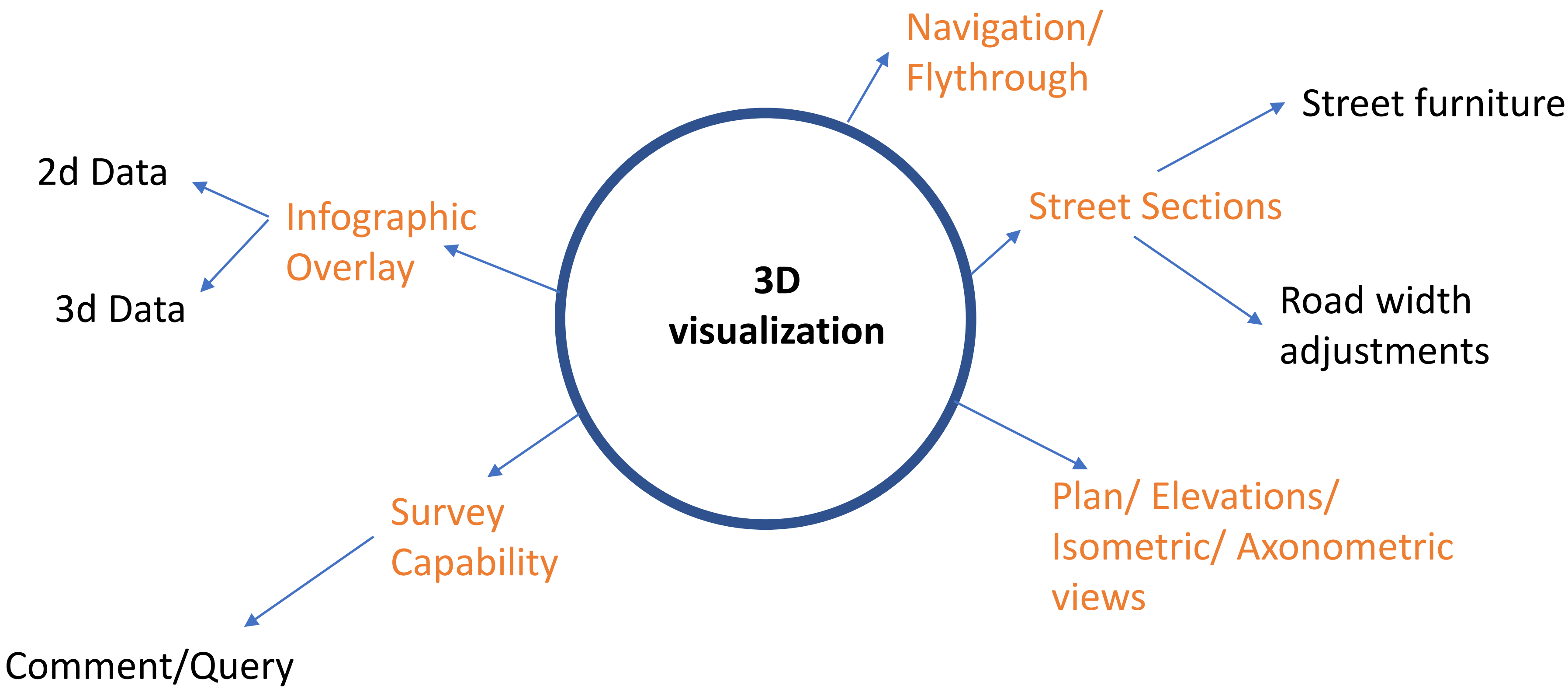


Image: Based on Pike (2009), Mahyar (2015) and Sorger (2015)iCity process phases, Taxonomy, iCity Team

Application and Visualization Prototypes

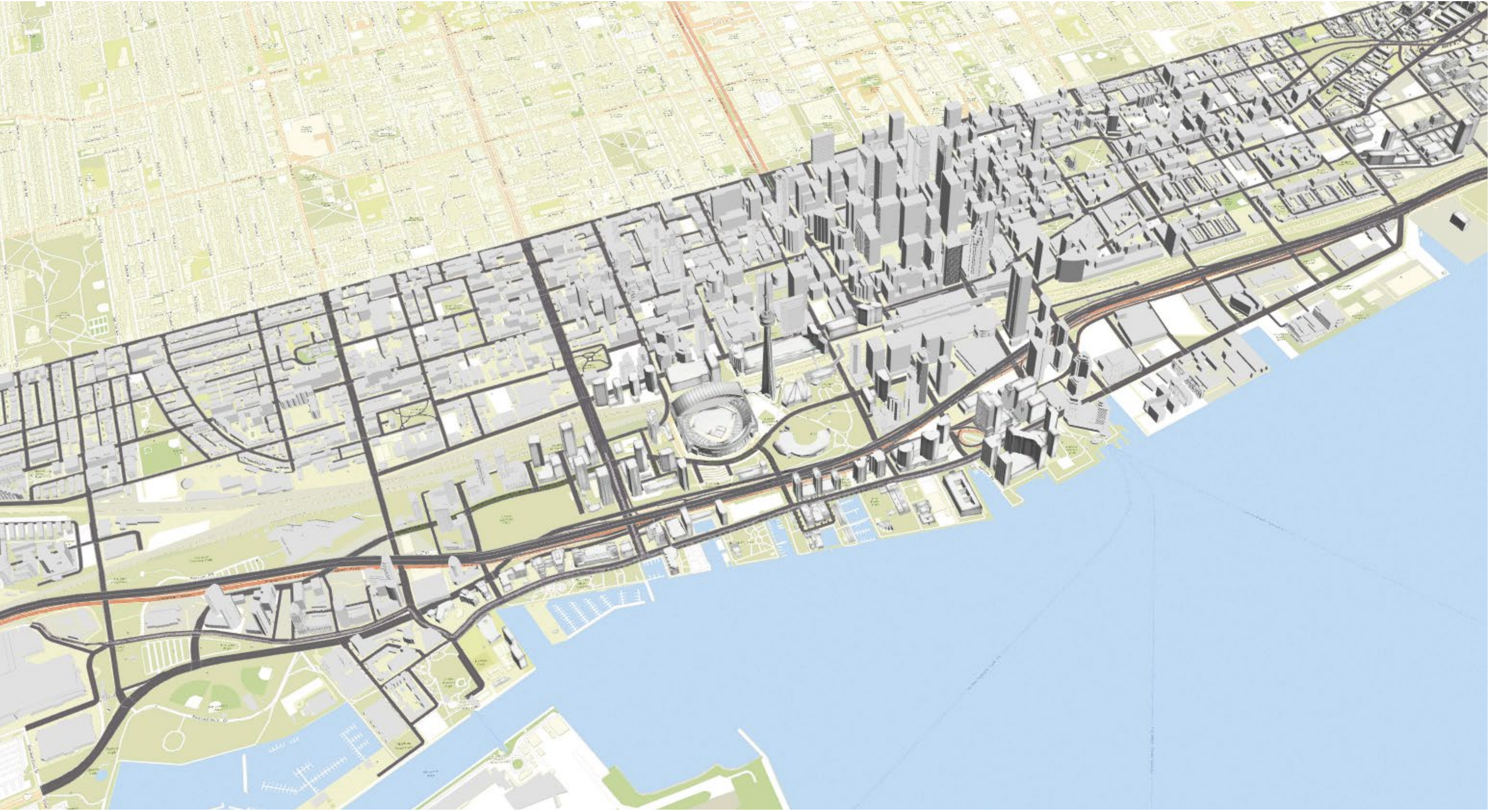
1. Geo-visualization analytic tools:

Complete Streets Research Software : Betaville, City Engine



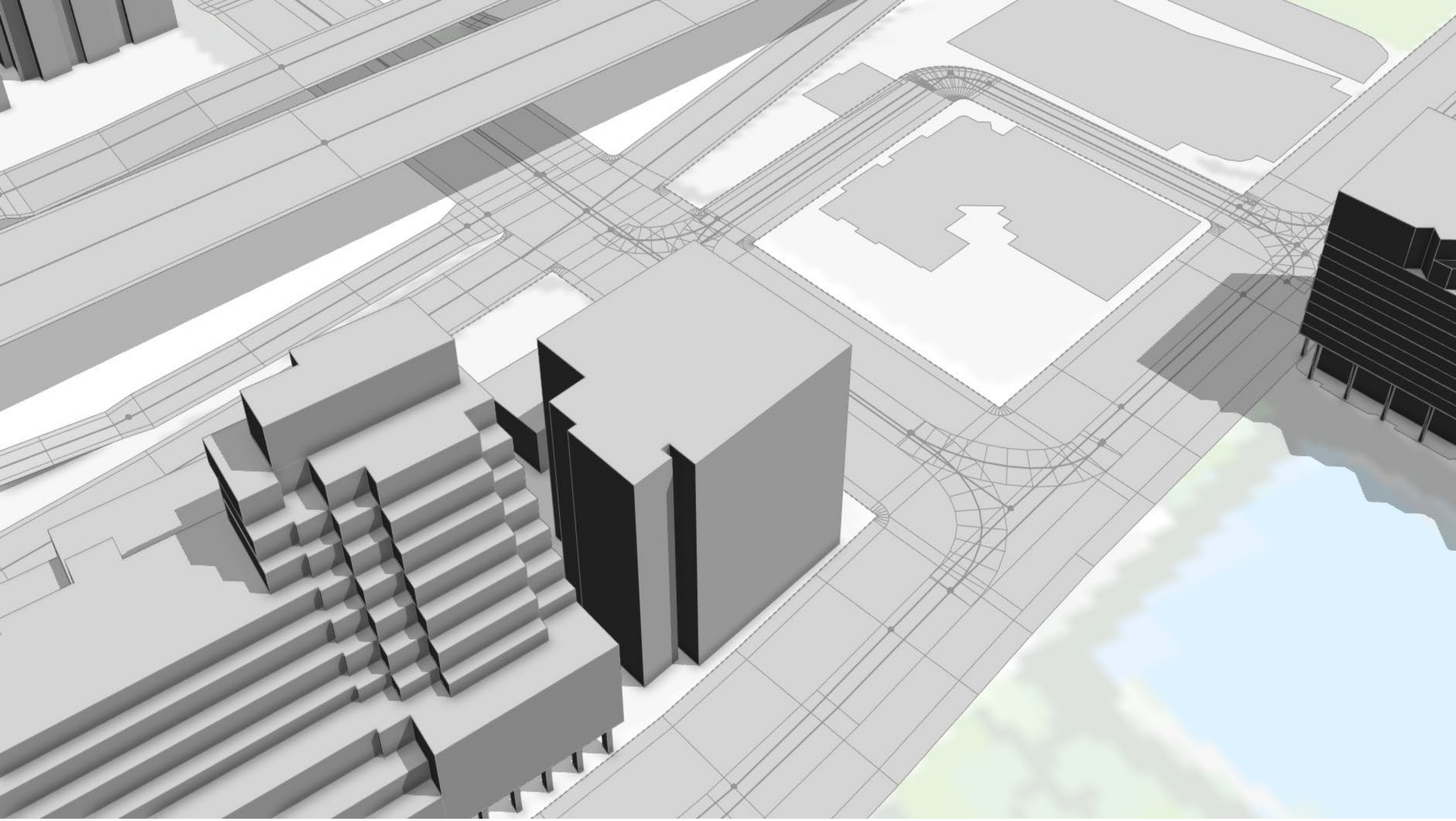
Visualization Prototype for Complete-Street interface

Image: iCity process phases, iCity Team



We are developing a realistic virtual model of city of Toronto

Image: iCity Waterfront Model, Esri CityEngine, Michael Carnevale, iCity Team



The model includes existing transportation routes, topography, built and natural environment within the city

Image: iCity Waterfront Model, Esri CityEngine, Michael Carnevale, iCity Team

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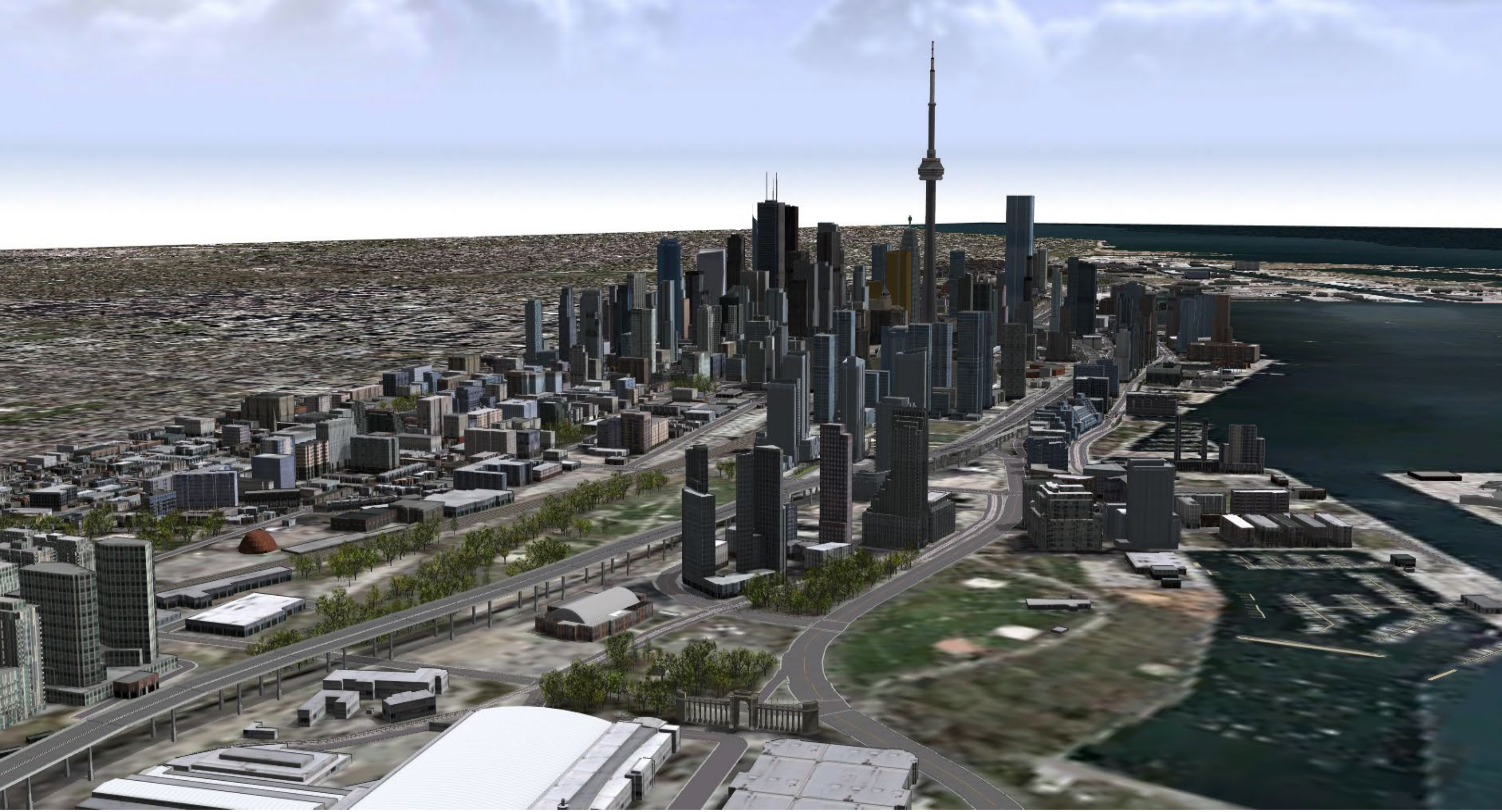


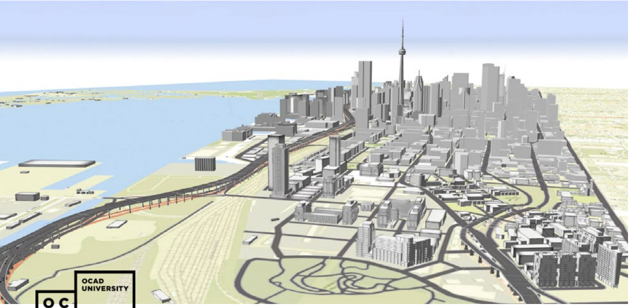
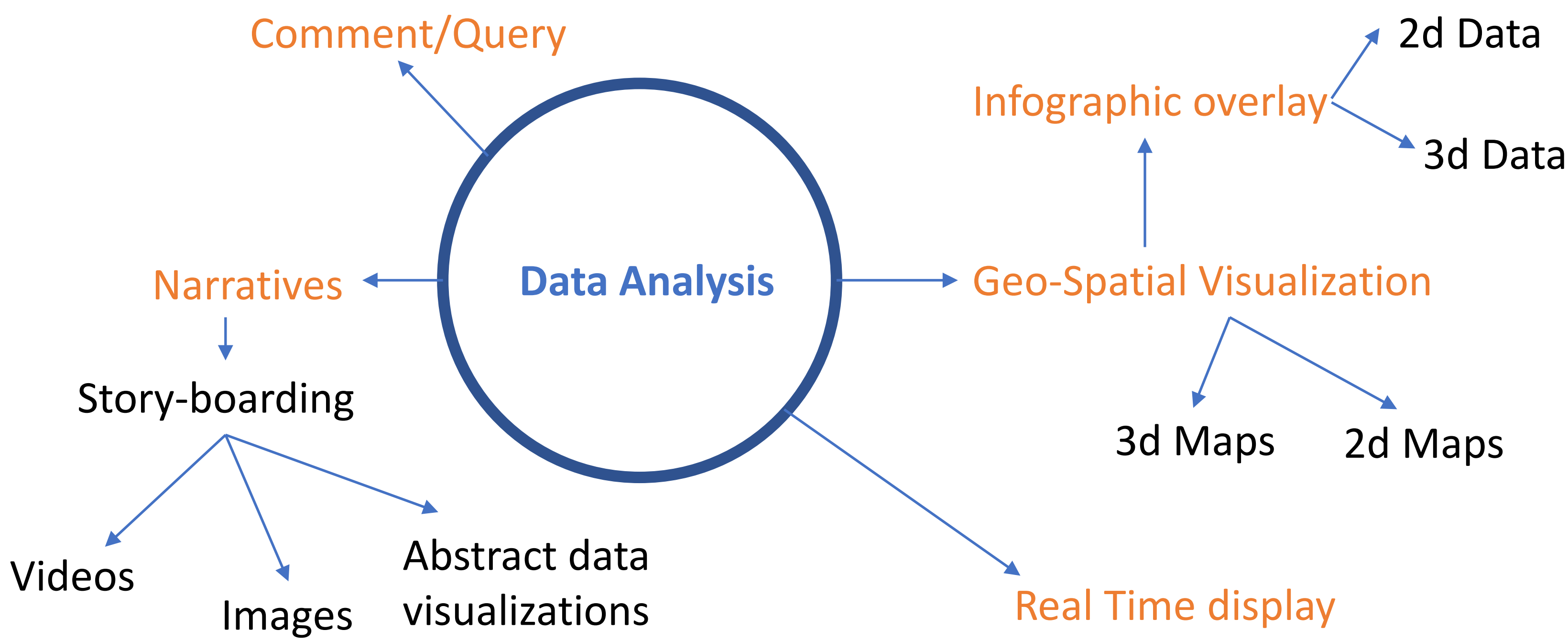


Image: iCity Waterfront Model, Esri CityEngine, Michael Carnevale, iCity Team

2. User-Stories and Data Analysis

Software -Story Facets, ESRI, IBM Watson Analytics, IBM Cognos



Visualization Prototype for Data Analysis interface

Image: iCity User Stories, iCity Team

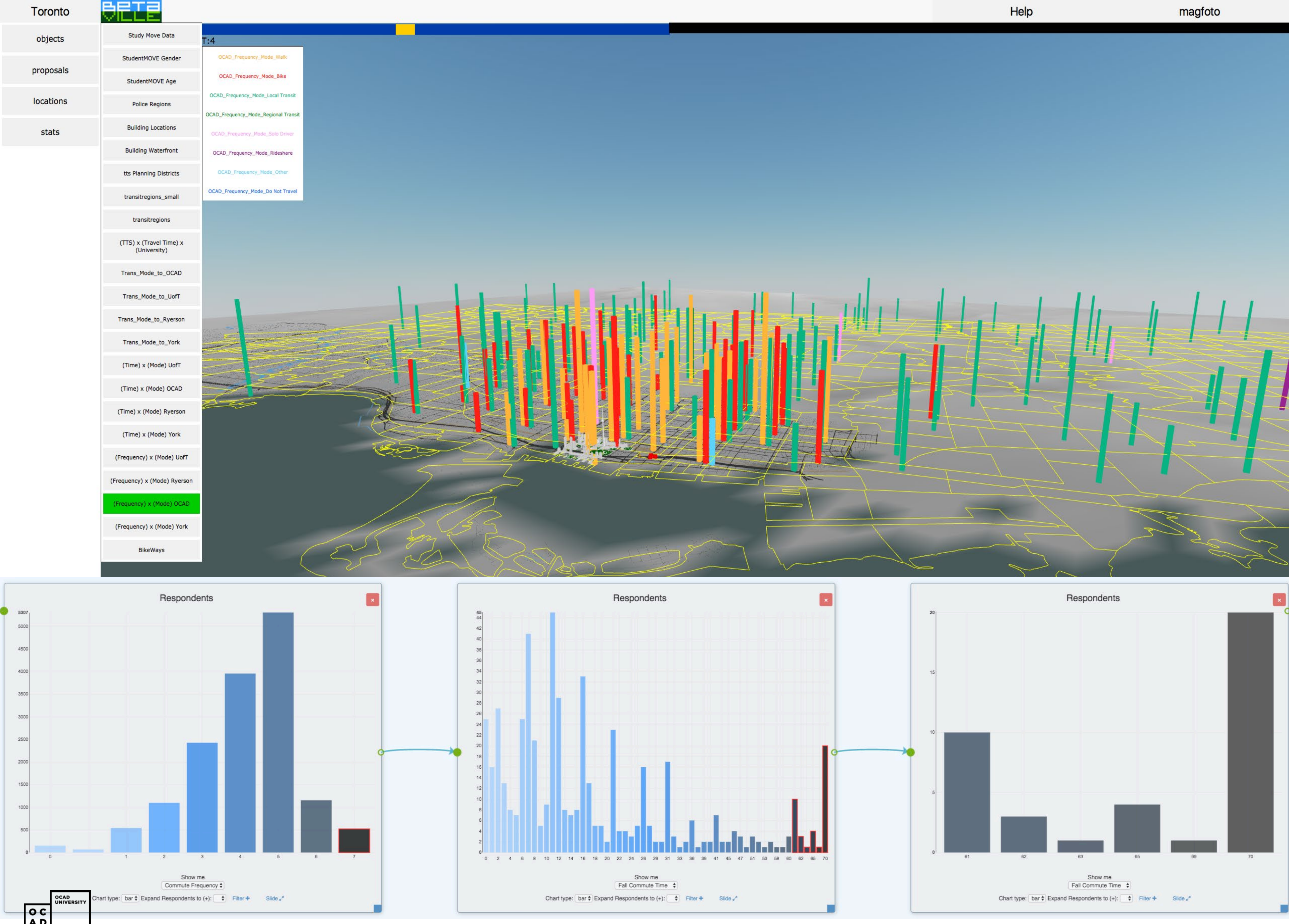
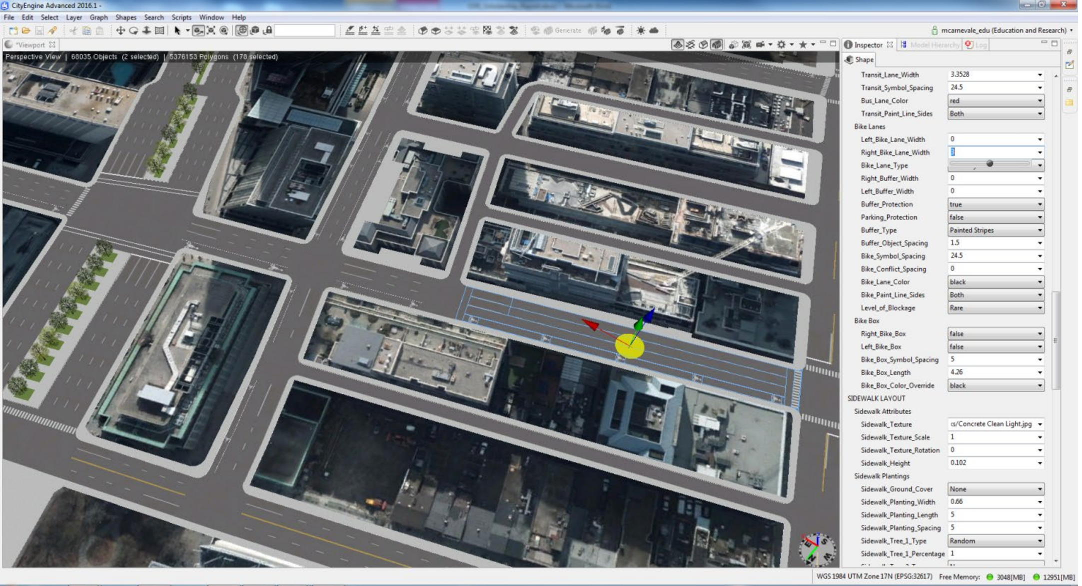
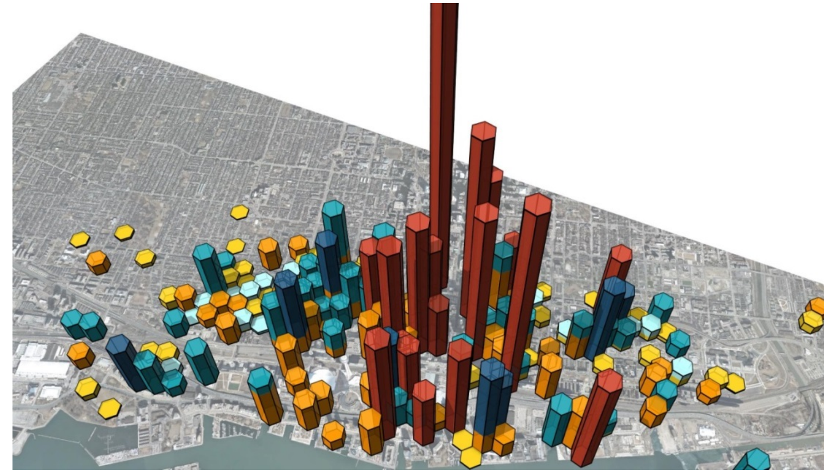
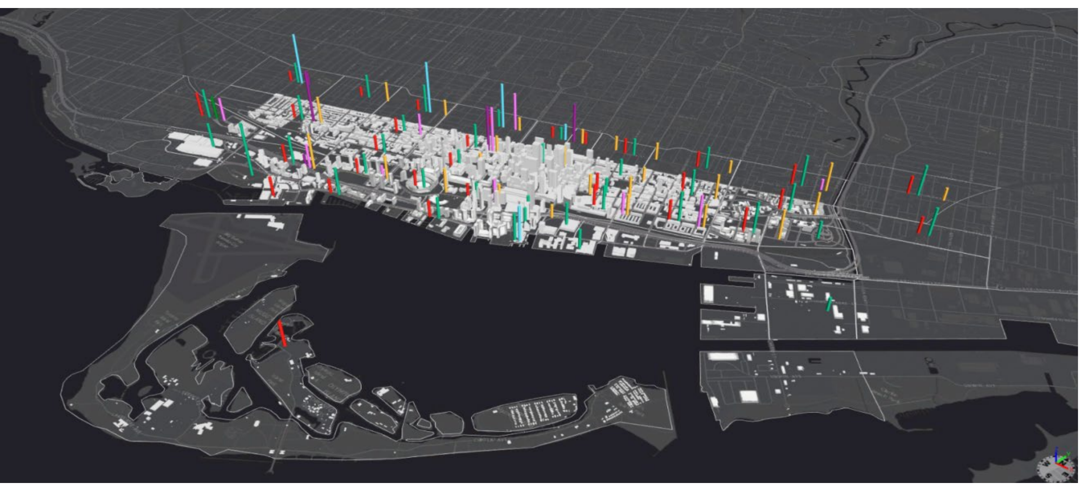


Image: iCity Geo-visualization using Betaville, 2d Analysis using StoryFacets; Davidson Zheng, Michael Carnevale, iCity Team

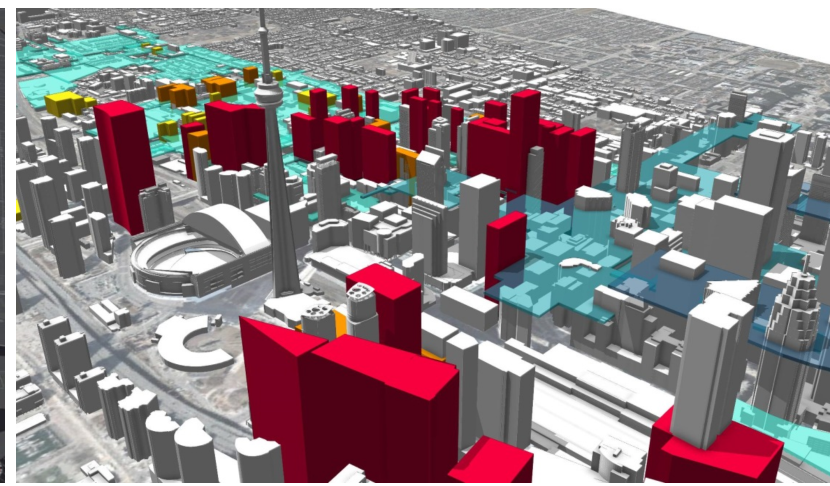




Registered parking availability by type and location



Travel modes and times to UofT



Building development height restrictions by zone

3d infographics overlay on 3d Map of the City of Toronto

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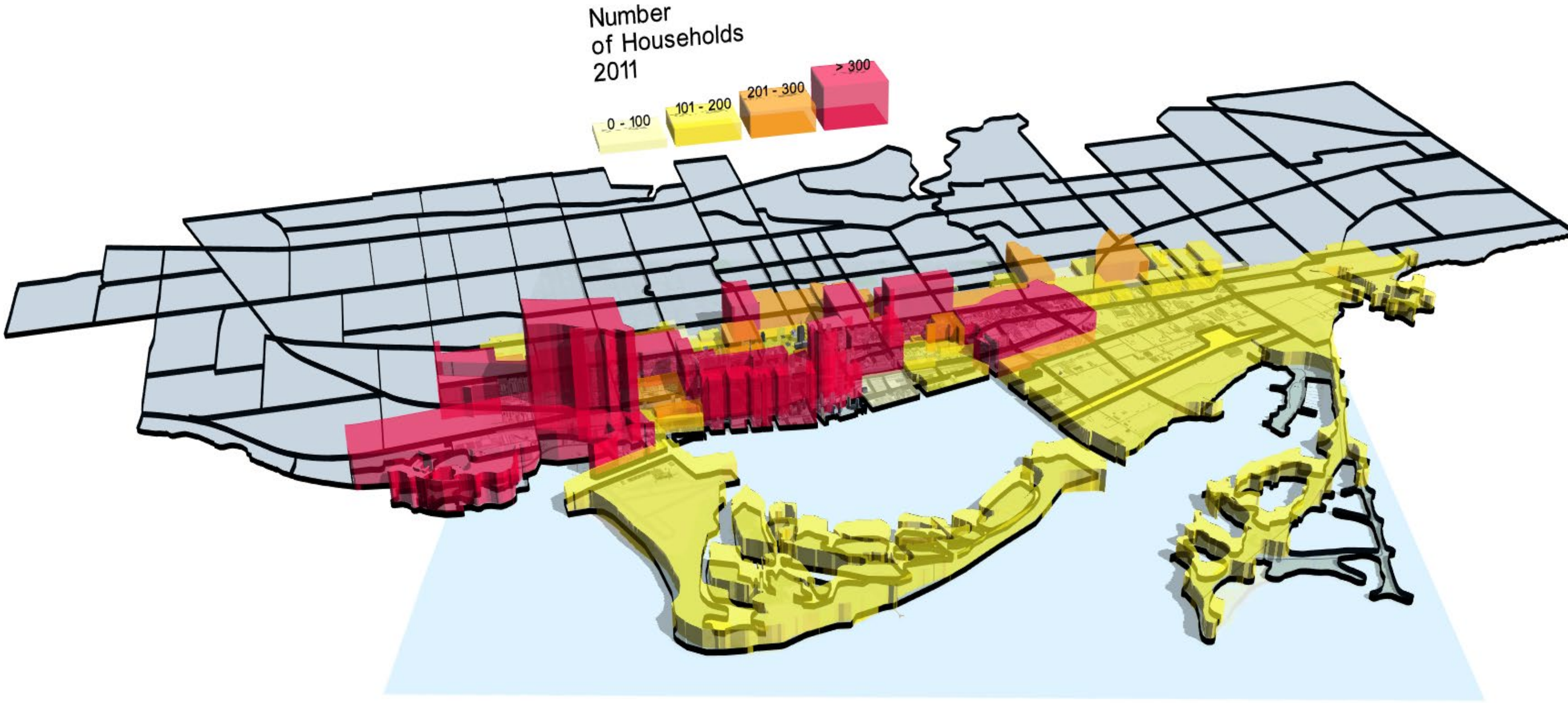
Image: iCity Esri CityEngine, and Betaville Model; Michael Carnevale, iCity Team



Integrated Data Analysis and Geo-visualization Mapping

Image: iCity Analytics; *Michael Carnevale, Carl Skelton, Marcus Gordon,* iCity Team

iCity as a Case Study Next Steps

Developing and Testing further working-prototypes with selected users to meet their priorities as outlined.

Validation of Taxonomy with expert users and citizens, to broaden it's application.

Creation of integrated dashboards, that collect and allow analysis of real – time data, to provide enhanced decision support.

In this way **users** of the systems can help **designers**, In identifying requirements, and address fundamental matters of **quality**, **equity**, and **social values**, with perspectives rooted in the experience of urban systems to mitigate uncertainty

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Questions ?