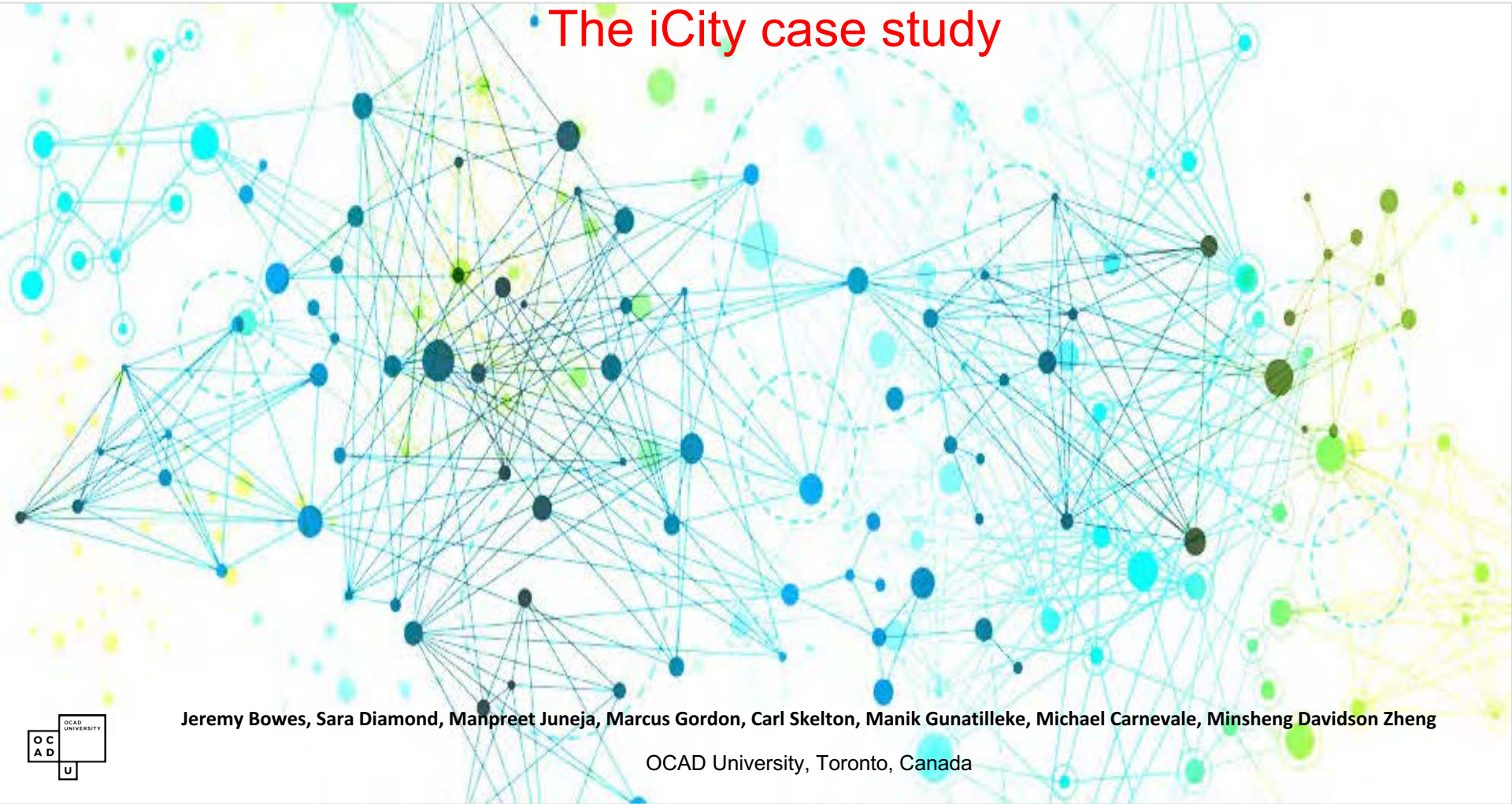
A User-centred Taxonomy for Urban Transportation Application Visualization

The iCity case study



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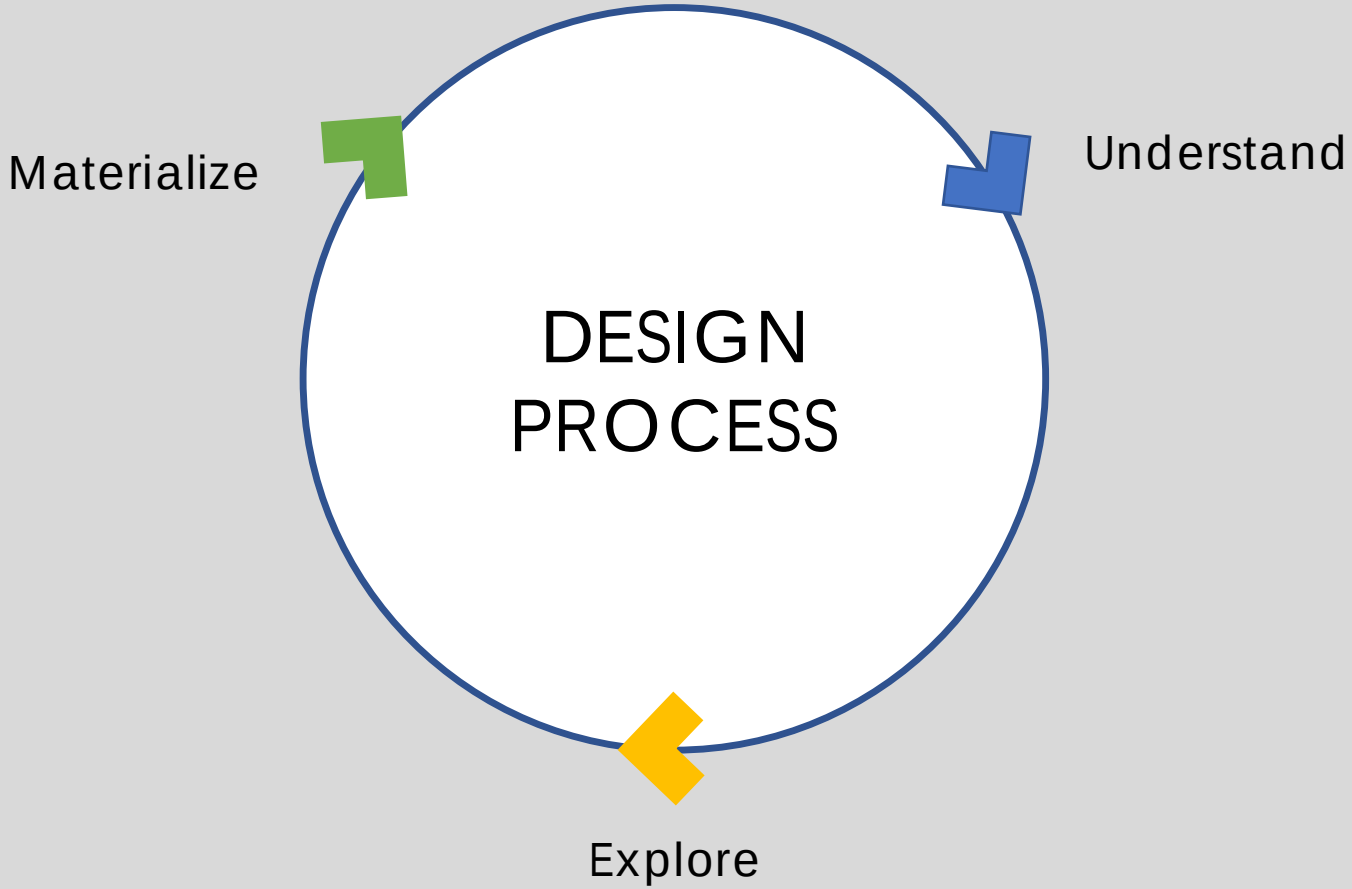
At the Visual Analytics Lab for iCity we are developing decision support tools combining social media and mobile data with GIS, demographic, socio-economic and transit data

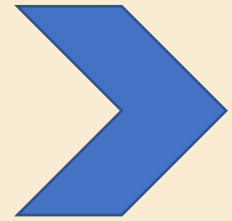
Image: iCity Visualization; ***ESRI cityengine, Betaville***, Carl Skelton, Marcus Gordon , Carnevalle, Manpreet Juneja



This work & paper focuses on a design process adopted to create a taxonomy prototype & framework for application for user – centred visualization interfaces.

Image: iCity Visualization; Jeremy Bowes, Manpreet Juneja

Research approach & process



Understand

- Literature Review / taxonomy
- Comparative Methodology in Urban Transportation software applications, tools and methods
- Expert Interviews

Image: Design Process, iCity process phases, Jeremy Bowes, Manpreet Juneja

Definitions

Taxonomy

Taxonomy can thus be understood as meaning ‘laws of arrangement and division’.

Eg: Library, arrangement of books

A taxonomy provides researchers with a common language with which to categorize and review existing systems, classify new ones and address gaps towards further development.
(Price, et al., 1993).

Image: goo.gl/LokQSx

Key Findings

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

Use Domains: Software Application Categories

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

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

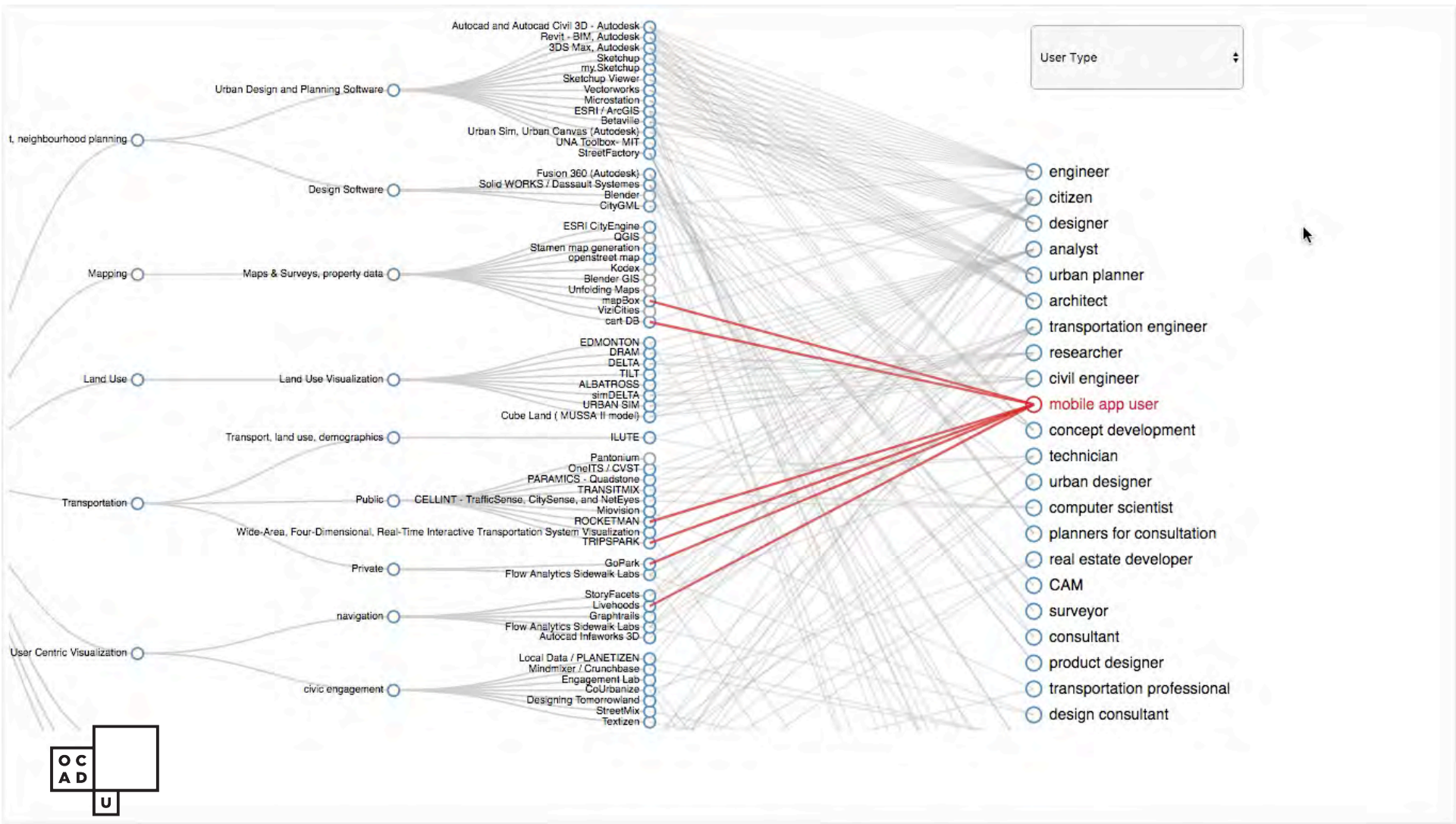
Comparative Methodology Categories of Table

Type of Urban System Application	Software	Technology / Platform	Description / application	User Type	Tasks (High Level)	Engagement Level
Selected Toolset / Methods						
Qualitative and Quantitative Data Exploration and Analysis and Presentation Tool	StoryFacets	HTML, Javascript, D3 framework, Meteor, MongoDB	Explore data through interaction, visual history, presentation, generate consumable overviews, high level -search /browser, visualization dashboard, visualization slide shows,	technicians, transportation engineers, citizens, Business analysts	dataset/media asset navigation, dataset visualization, dataset history and analysis history visualization, decision support	expose (consuming, learning and viewing) involve (interacting) analyze (finding trends) synthesis (testing hypothesis) Decide (Deriving decisions),

Interaction (Low level tasks)	Data Visualization	Data Attributes	Open / Private Data Source	Data Format (input)	File Format	Link	Contact
zooming inset, brushing and linking, scrolling, panning, filter, pivot, compare	Bar chart, Pie chart, Gather plot, Markup language	Categorical, Ordinal, Interval, Provenance, audio, video, text, image	Agnostic	Tabular, Markup	CSV (Comma Seperated Values), Markdown	storyfacets-test.herokuapp.com	Cody Dunne

This survey helped us in aggregating User Types, Use Domains, User Tasks, and the type of Data being used for Urban Transportation Applications, and we recorded the info into a large spreadsheet database.

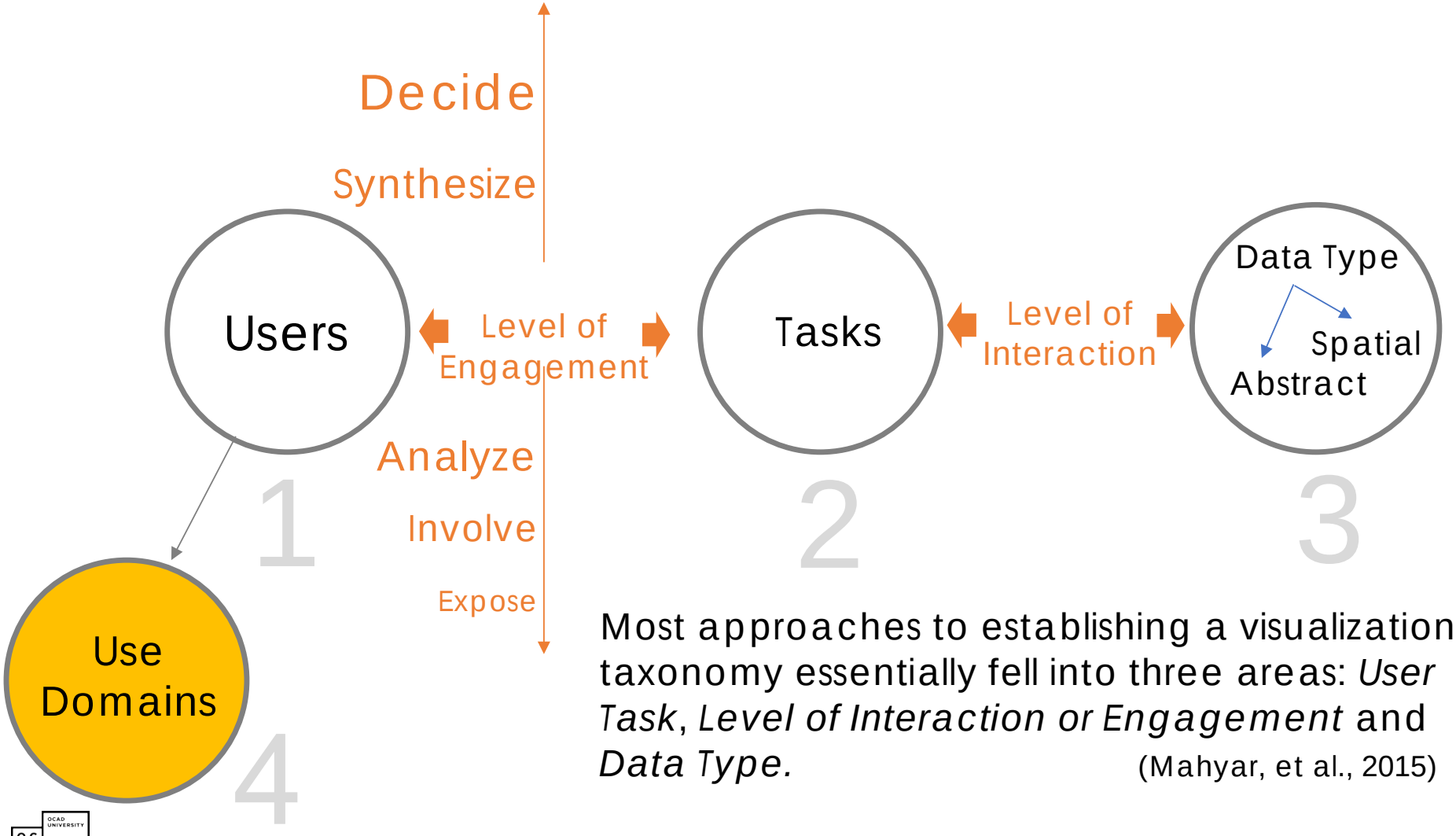
Image: Comparative Methodology Database, iCity process phases, Manpreet Juneja, Marcus Gordon, Jeremy Bowes



The VAL research assistants Marcus Gordon, Davidson Zheng and Michael Carnevale, created a first iteration of a web based prototype. This allowed for the dataset modelled from the master spreadsheet, to be explored interactively.

COMPARA prototype - Mapping Relationships: VAL RA's, Marcus Gordon, Davidson Zheng and Michael Carnevale

Taxonomy Sketch showing essential aspects of visualizations



Most approaches to establishing a visualization taxonomy essentially fell into three areas: *User Task*, *Level of Interaction or Engagement* and *Data Type.* (Mahyar, et al., 2015)

Image: Design Process, iCity process phases, Manpreet Juneja

Research approach & process

Explore

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

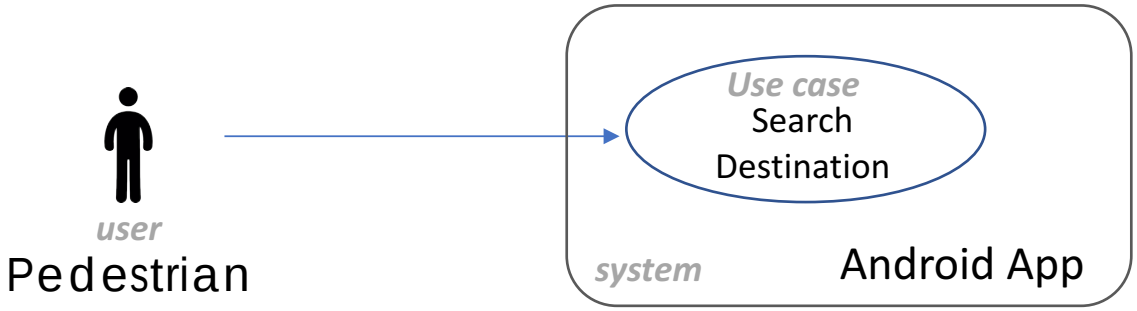
Thus, the challenge is to ensure diverse groups of users have appropriate levels of accessibility to data in usable forms, which in turn requires understanding the visualization needs of multiple user groups.

Image: iCity Visualization; Jeremy Bowes, Manpreet Juneja

Definitions

Use Case

A *use case* is a series of related interactions between a user (or more generally, an "actor") and a system that enables the user to achieve a goal.



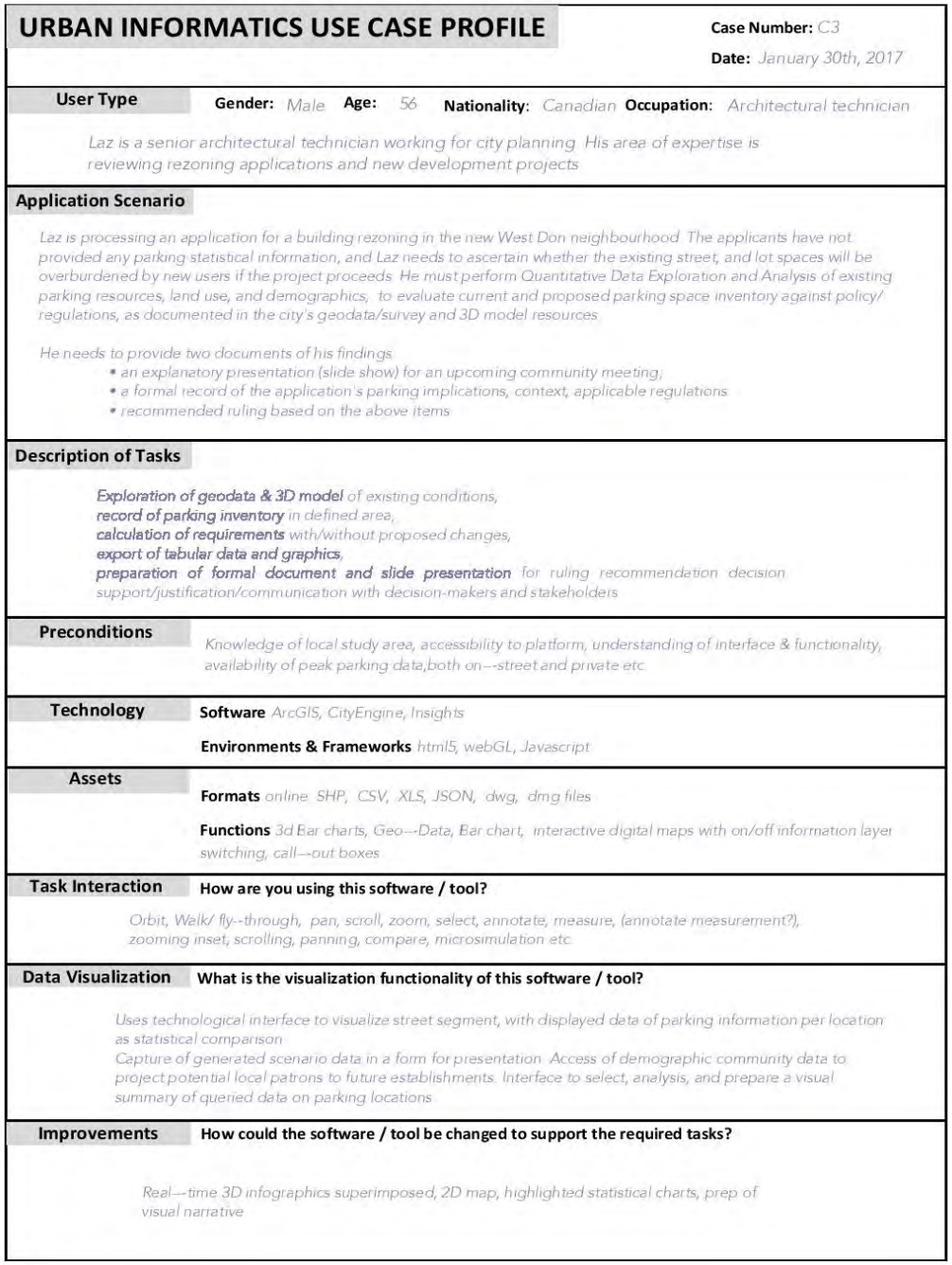
Whether experts or casual users, different user groups can have varied information-seeking motivations and objectives, and desire diverse representations of urban data.

Eg: Pedestrian searching a destination

Image: Diagram, Manpreet Juneja

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

Selected Integrated Use Domain Example

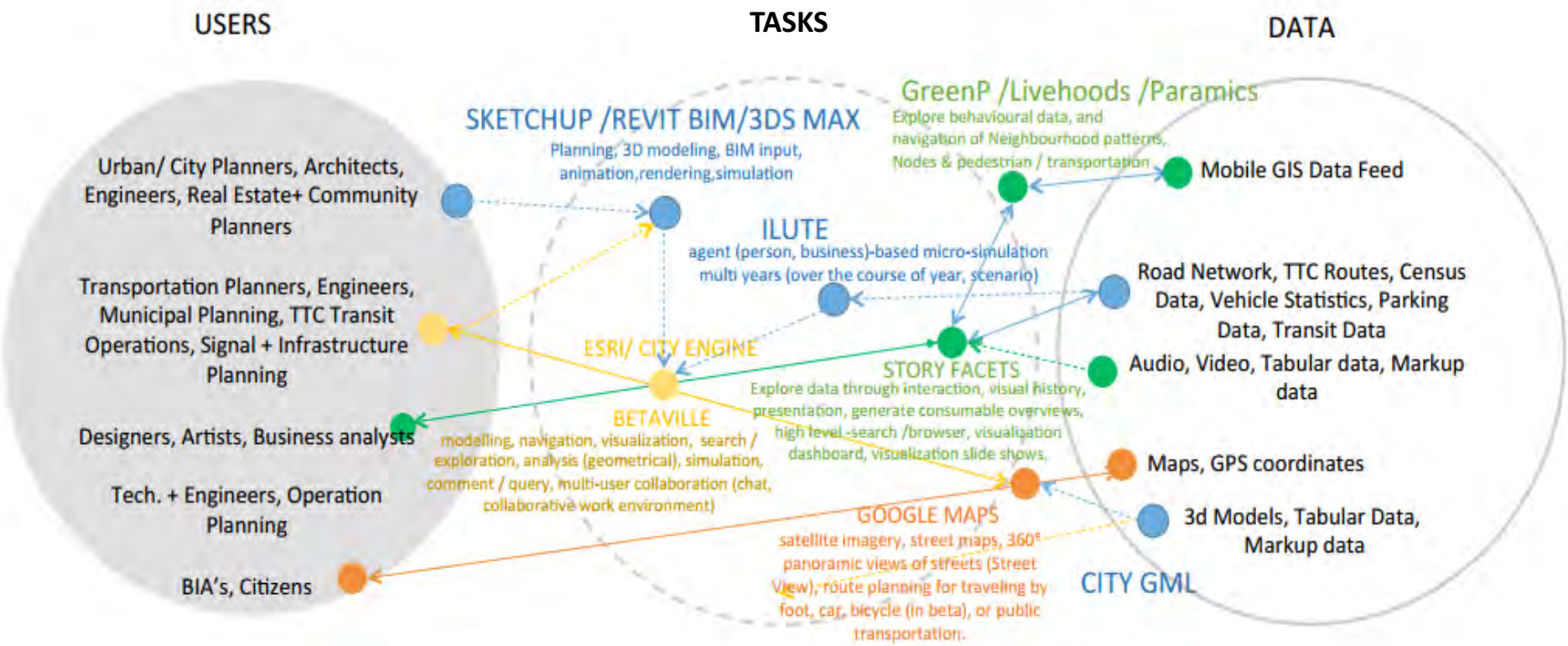
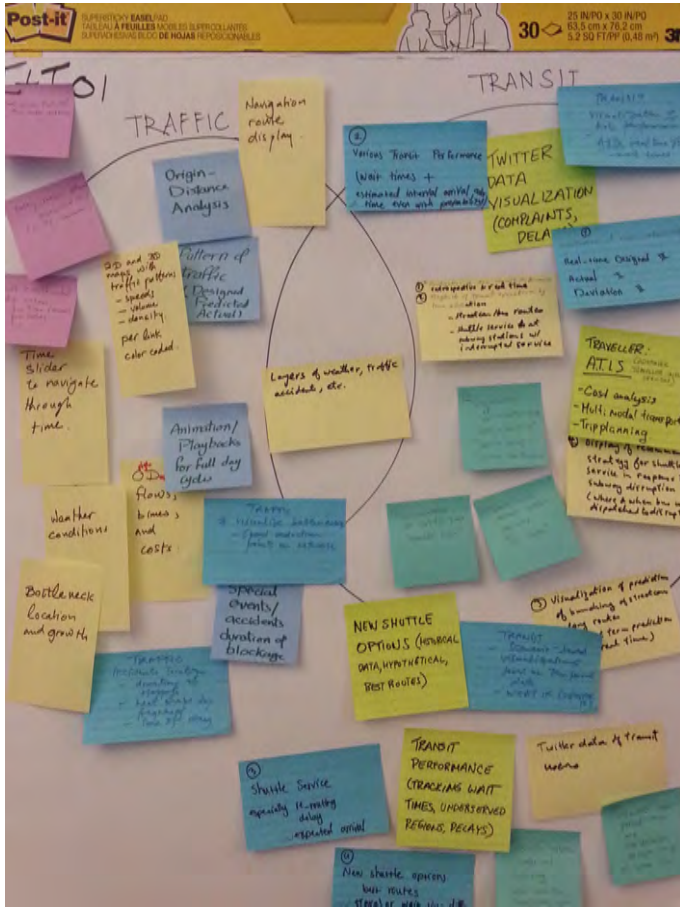
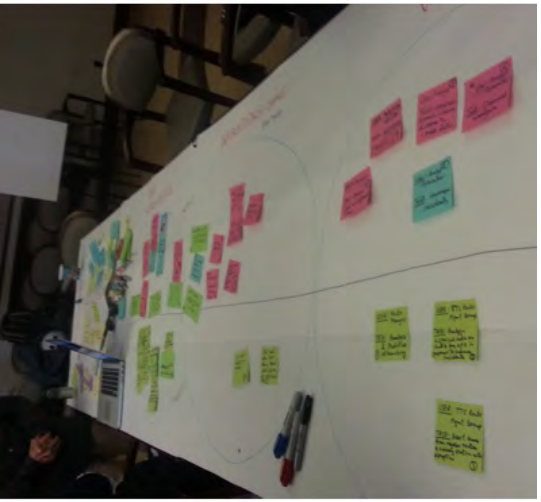


Image: Use Case Mapping - Users, Tasks and Data, Jeremy Bowes, Manpreet Juneja, iCity Team

Design Charrette

Test Taxonomy Sketch
Establish priorities to build interface prototypes





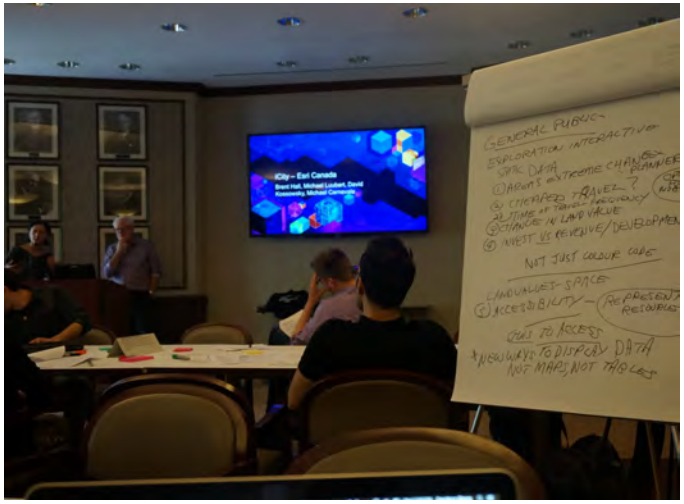


Image: Charrette Images, iCity process phases, iCity Team

Research approach & process

Materialize

- User-Centred Taxonomy for Urban Transportation Applications - Template
- Applications and Visualization Prototype implementation

- *Design a taxonomy prototype that qualifies types of users, use domains and detailed context of use, integrates user engagement goals with the essential components of visualization, and highlights the end user and their intended interactions with the visualization.*

Image: iCity Visualization; Jeremy Bowes, Manpreet Juneja

User-centred Taxonomy for Urban Transportation Applications

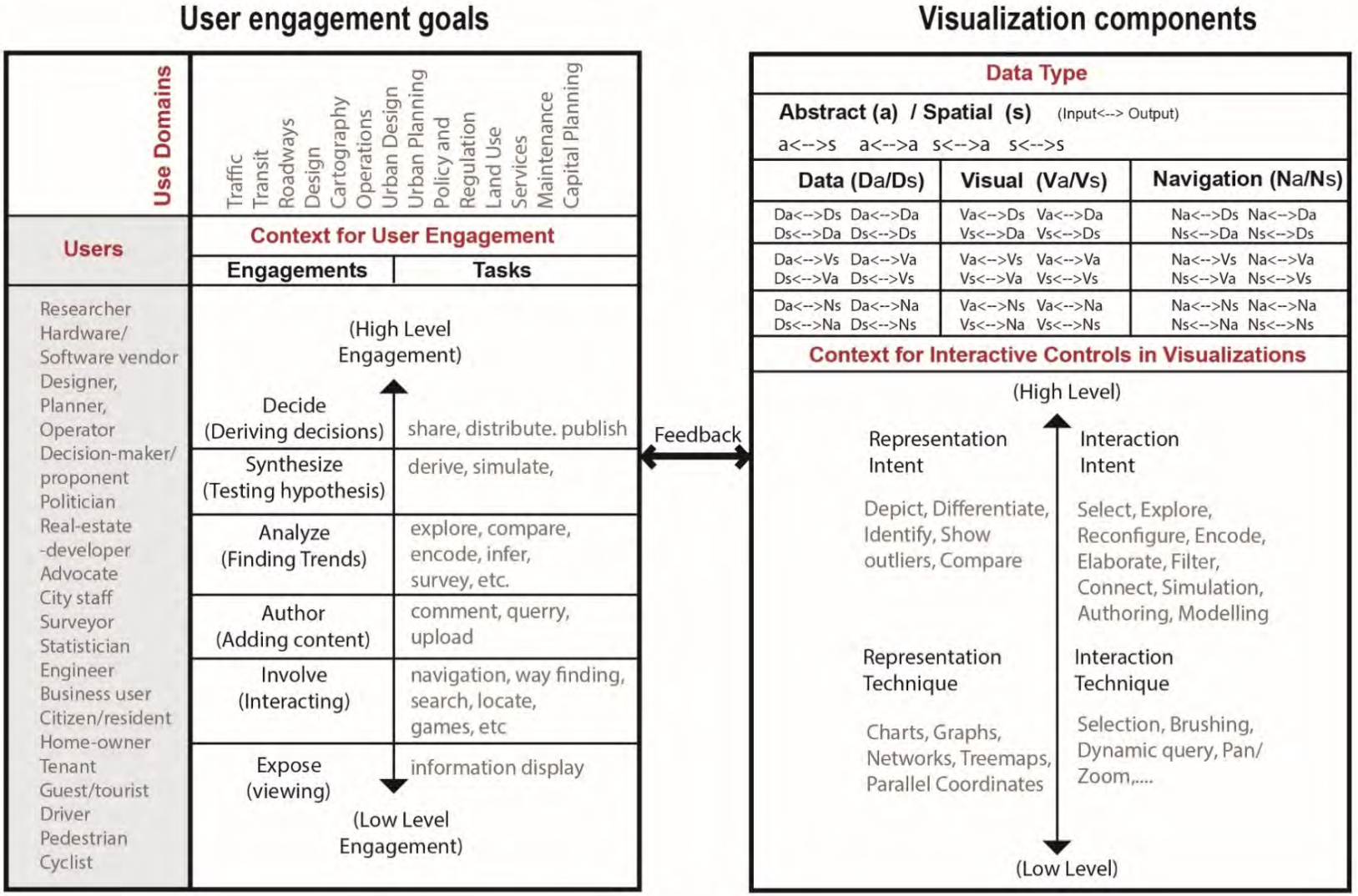


Image: Based on Pike (2009), Mahyar (2015) and Sorger (2015), iCity process phases, Taxonomy, iCity Team

Testing the Taxonomy template

Use Case – *the architectural technician*

This *use case* from our user group research depicts the technician working on the review of a rezoning proposition for a new building. Two main tasks occupy this technician's work on such a project:

(1) the exploration of datasets, and
(2) analysis of land use, parking resources, and demographics.

Using our template taxonomy chart, we can first classify our user engagement goals with the technician as *user* and urban planning as *use domain*.

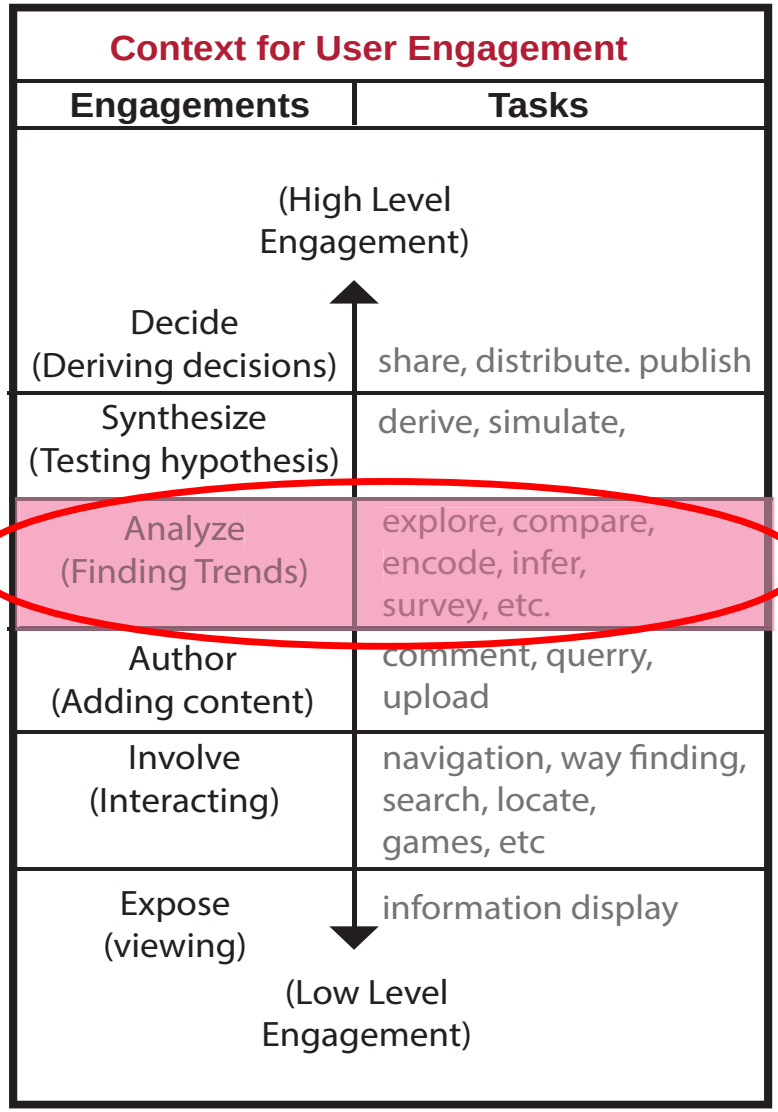
Use Domain of the Architectural Technician tasks

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

Use Case – *the architectural technician*

- technician is required to perform quantitative data exploration and analysis in order to determine if the building application in question would create any issues with parking lot spaces being overwhelmed by new users.

- the taxonomy's user engagement context would classify this technicians' activity as *analysis* and the finding of trends, (to unravel the patterns that will help the technician to generate decision support data for synthesis.



Architectural technician's User Engagement

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

Use Case – the architectural technician

- In Sorger et al.'s (2015) model-based taxonomy, *integration* is triggered through interaction.
- *a source domain is what the user interacts with*, and in the architectural technician example, these include sheets, tables, maps and charts.
- *the target domain is what is affected through the integration*. If the source and target domains are the same, they are of *coordination* rather than *integration*. These tables, maps, and charts are both source and target domains in the case of the technician's GIS software used.

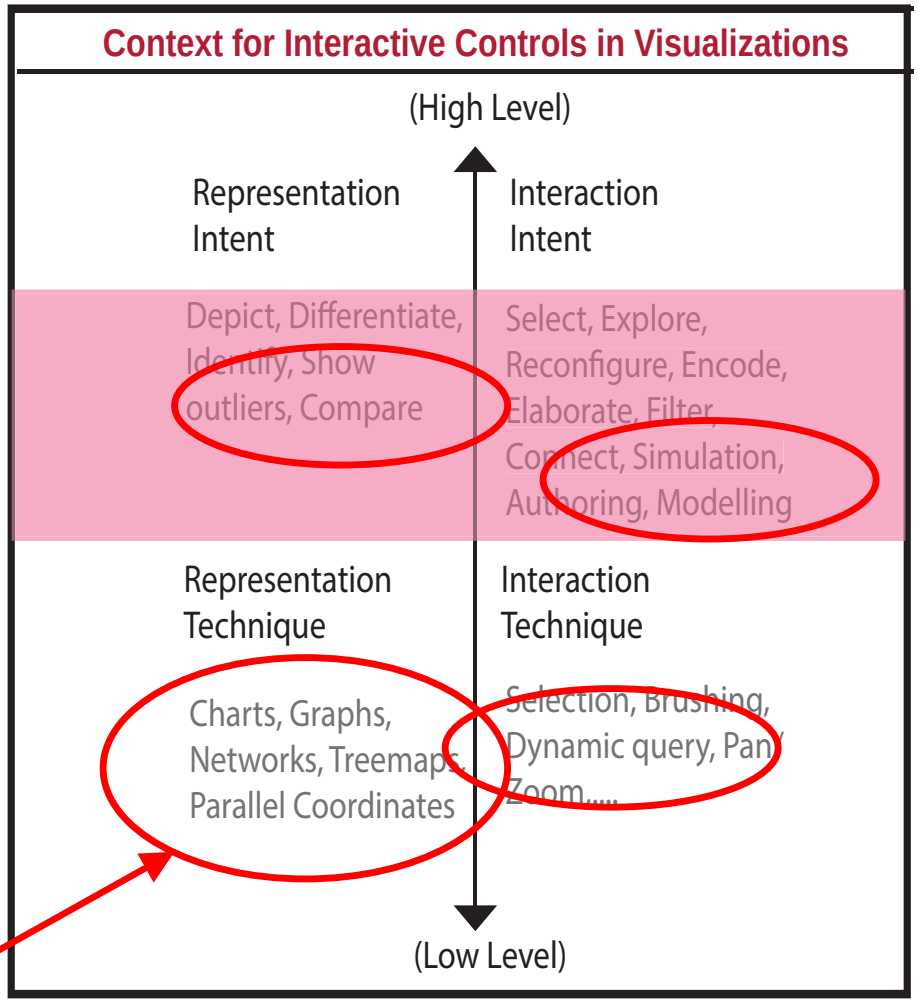
Data Type		
Abstract (a) / Spatial (s) (Input<--> Output) a<-->s a<-->a s<-->a s<-->s		
Data (Da/Ds)	**Visual (Va/Vs)**	**Navigation (Na/Ns)**
Da<-->Ds Da<-->Da Ds<-->Da Ds<-->Ds	Va<-->Ds Va<-->Da Vs<-->Da Vs<-->Ds	Na<-->Ds Na<-->Da Ns<-->Da Ns<-->Ds
Da<-->Vs Da<-->Va Ds<-->Va Ds<-->Vs	Va<-->Vs Va<-->Va Vs<-->Va Vs<-->Vs	Na<-->Vs Na<-->Va Ns<-->Va Ns<-->Vs
Da<-->Ns Da<-->Na Ds<-->Na Ds<-->Ns	Va<-->Ns Va<-->Na Vs<-->Na Vs<-->Ns	Na<-->Ns Na<-->Na Ns<-->Na Ns<-->Ns

Source and Target Data Types of Use Case Example

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

Use Case – the architectural technician

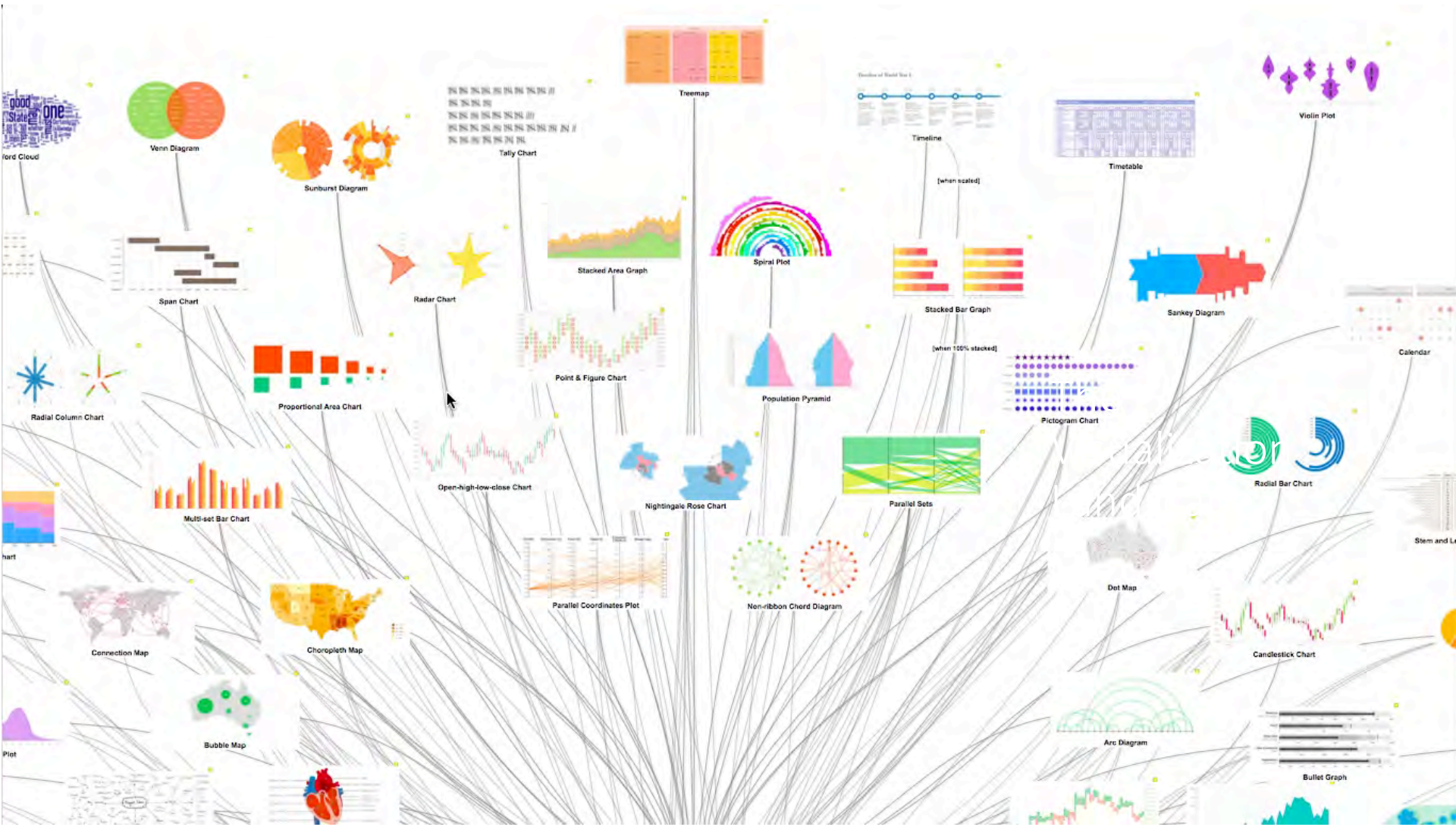
- The technician's work in this use case involves geospatial data, making use of (a) abstract and (b) spatial data types.
-
- The use case also identifies the technician's use of geographical information systems (GIS) software, web, and graphic frameworks.
- Components of the ArcGIS software gives the technician the ability to explore abstract data in the form of information visualizations and provides the technician with a host of spatial navigation features.



Use Case Example's Interaction Model

Vizland suggested options are added here

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



The visualization landscape project (VIZLAND for short)

The ability to query keywords associated to these visualizations is to give the user quick access to matching keywords that relate to the visuals. This is done by the user typically matching functions that are prominent in selected visualizations.

Image Data Source: Severino Ribecca, Data Visualization Catalogue, VIZLAND development By Marcus Gordon, VAL

USER CENTRED TAXONOMY
Use Case – the architectural technician

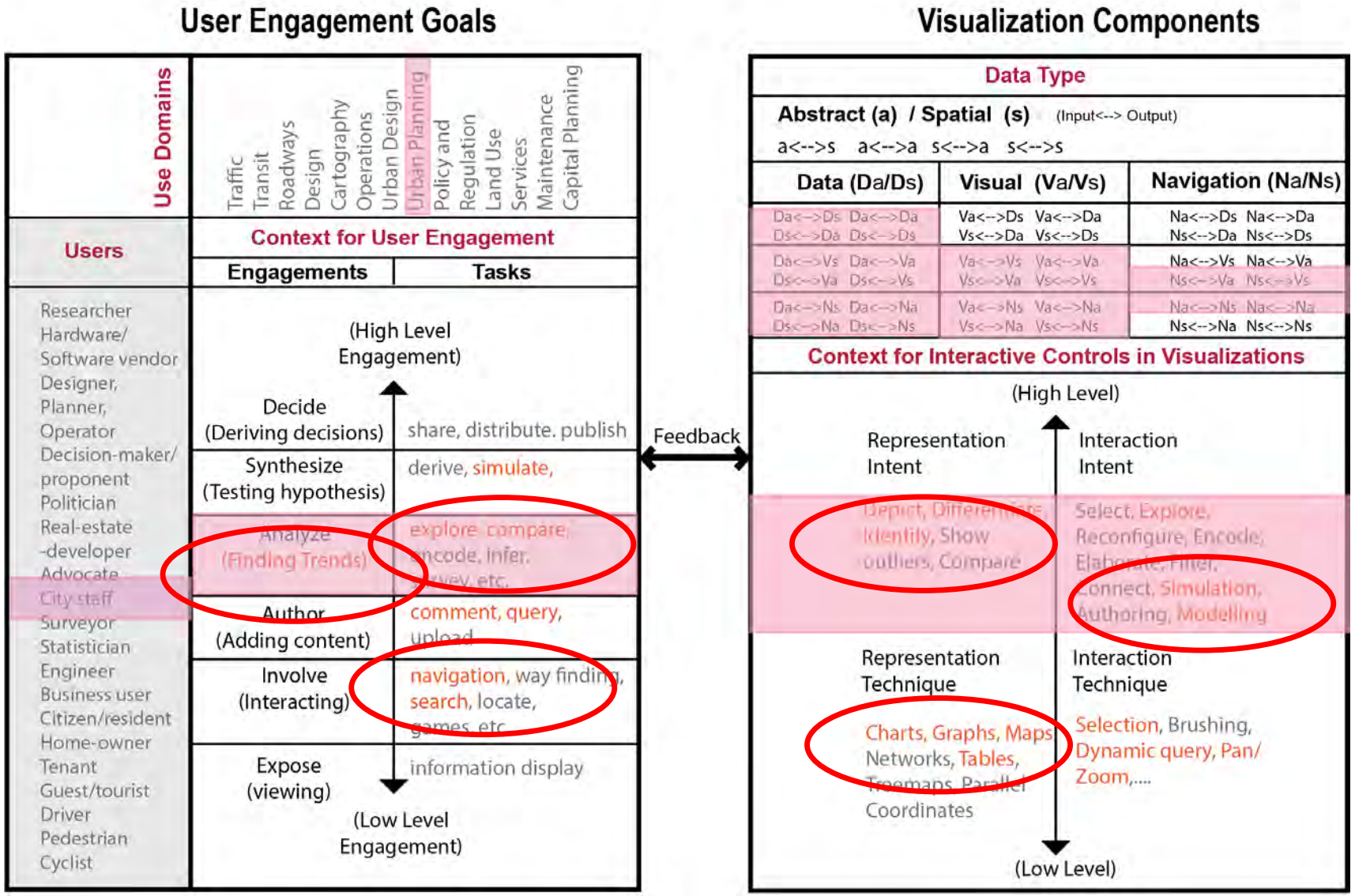
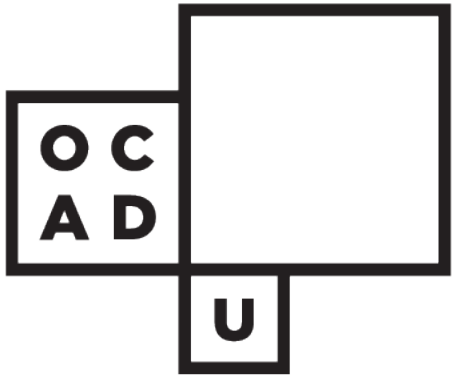


Image: Based on Pike (2009), Mahyar (2015) and Sorger (2015), iCity process phases, Taxonomy, iCity Team

Conclusions

- These findings focused our approach to establishing a visualization taxonomy focused on three areas: *User Task*, *Level of Interaction or Engagement* and *Data Type,* and the detailed classification of interactive elements based on user tested needs for *spatial and non-spatial data types* within our research groups.

- The *taxonomy* prototype outlines a key framework to create a series of *interactive dashboards* that provide the integration of these functional user elements to provide visualization support for a variety of users.



Questions ?

Acknowledgements

The authors gratefully acknowledge the support of OCAD University and the Visual Analytics Lab, Canada Foundation for Innovation, the Ontario Ministry of Research & Innovation through the ORF-RE program for the iCity Urban Informatics for Sustainable Metropolitan Growth research consortium; IBM Canada and MITACS Elevate for support of post-doctoral research;, NSERC Canada CreateDAV, and Esri Canada and MITACS for support of graduate graduate internships; Artjem Disterhof at the Media2Culture (M2C) Institut für Angewandte Medienforschung at the University of Applied Sciences of Bremen for development work on the Betaville html5 prototype; the Rockefeller Foundation through its Cultural Innovation Fund; Microsoft Research; the Bundesministerium für Bildung und Forschung; and the department of Informatics of the City University of Applied Sciences, Bremen.

THANK YOU!

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