Proposed CASCON 2017 Smart Cities Workshop Session Outline

Creating a User-centred Taxonomy to Serve Urban Transportation Applications

Keywords: Smart Cities, Design, Data Visualization, Taxonomy

Abstract:

Over the last decade, the adoption of smart urban software and IT infrastructure systems has had profound economic and societal impacts, while multipying the complexity of data and the variety of domains of practice called upon to interoperate. Development of a current user-centred and visually interactive taxonomy of such systems has become necessary, to help ensure appropriate kinds and levels of accessibility and usability for a diverse group of users, including but not limited to the actual *operators* of those technologies. Visualization and visual analytics tools in particular provide critical support for a wide variety of experts and stakeholders to understand transportation flows and related human activities in smart cities.

We are conducting research to create a new taxonomy for urban transport-related visualization and decision support systems as part of iCity/Urban Informatics for Sustainable Metropolitan Growth, an integrated academic-industry research and development project to advance the state of the art for urban transportation planning and decision-making tools and practices for smart cities.

The proposed workshop will be an early-stage prototype review, part of the design process for a 'User-centered Taxonomy for Urban Transportation Applications' interactive online map to be developed by the Visual Analytics Lab at OCAD University, which will serve in establishing a framework for dashboard and user interface design for urban transportation applications.

Rationale

A general survey of visualization system taxonomies provides an understanding of the various methods used by researchers in the field of visual analytics to organize data, user tasks and visual elements into meaningful representations. Through our research, we have found that such taxonomies classify visualizations based on data type and user task, specifically focusing on quality and relevance of representations. Less typically, user-centric taxonomies base their categorization on research in cognitive science, where most of the visualization tasks and user groups are very specific and well-defined.

Greater complexity arises when one particular visualization or environment is required to serve multiple user types, as we find with visualizations displaying urban transportation data simultaneously addressing urban designers, city planners, data scientists, engineers, transit managers, pedestrians, and commuters. These diverse user groups can have very different data visualization motivations, objectives, and skill levels, usually different from those of the experts directly interacting with the software. Although data visualization and visual analytics can empower non-users to make sense of their data,

challenges arise when a single design visualization must address a diverse audience (Mahyar, et.al., 2015).

Through our research, we have come to realize that there is a crucial step to be taken before considering the content of the representation and its quality, to create effective representations at urban scales to serve the full spectrum of user groups: a comprehensive dashboard to fully represent the variety of user types in terms of their requirements and capabilities for intended user tasks.

Given the scale of the iCity project, it is important for us to understand who the user groups were, what were they looking for, and the functionality/support currently provided by current platforms.

Comparative Methodology:

Research in visual analytics shows that it is through interactive manipulation of the visual interface - the analytic discourse, that the knowledge is created, verified, refined and shared (Pike W. A. et.al., 2009) Therefore there exists a relationship between human cognition and interaction with visualizations. The basic idea behind visual analytics is that the visual interface supplements human insights, underscoring the importance to study human goals and tasks, to design effective interactive interfaces of visual components that support knowledge creation and sharing.

We began with a scan of the eco-system of urban-transit applications, to understand the environment of “Comparative Methodologies”. Our effort around comparative methodology was to survey a wide range of software applications being utilized in the related fields domain, and, to understand the user groups being served and the tasks being accomplished. We did this in tandem with a literature review of a Taxonomy for visualization, which further helped us to define the criteria for evaluation for each of the software we were studying.

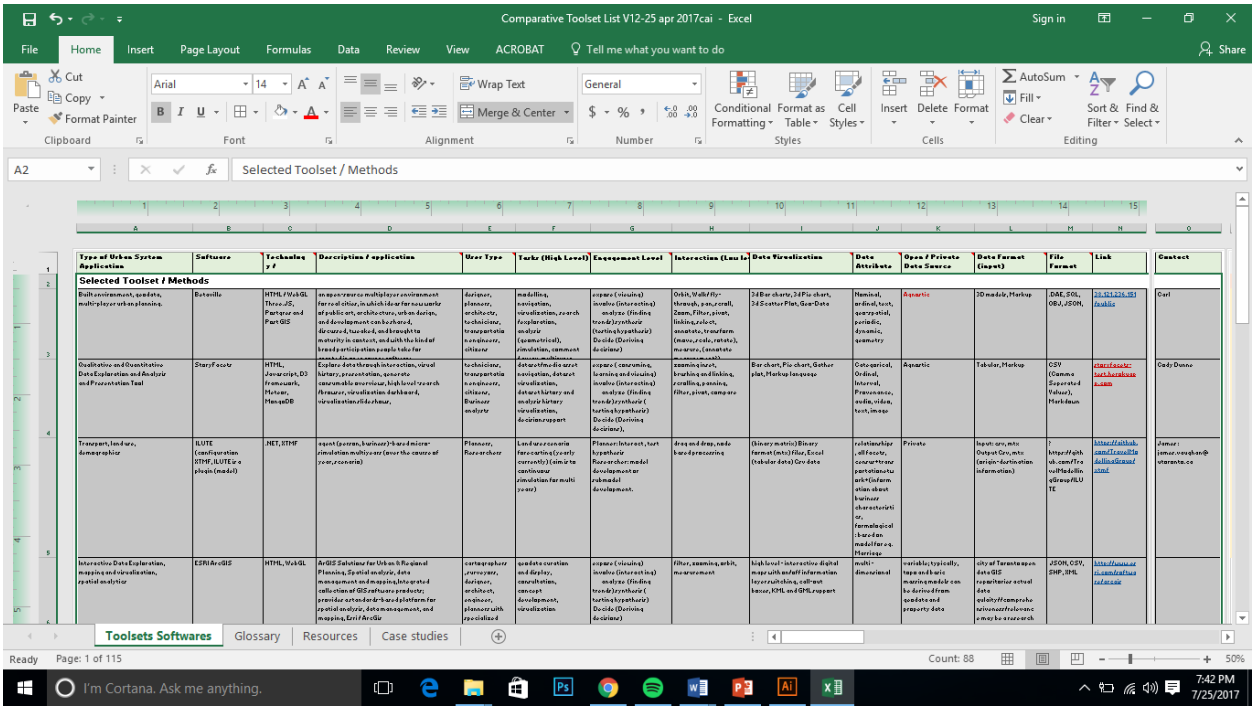

Figure 01: Comparative Methodology chart

The environment scan for the existing software applications and technology gave us broad classifications of software applications serving urban transit analysis, research, and planning, along with the application of systems in related fields. The categories of software systems applications were defined under the following headings: User-centric software for transit, Transportation, Mapping and Traffic, Urban Design: Built Environment, Land Use, Big Data & Analysis, Infrastructure Management, and Entertainment & Games.

The software categories defined our rows and the guiding questions for each column served to detail and define each software in the respective category.

Design process for User-centered Taxonomy Prototype

User-centred Taxonomy Prototype 01:

Our exploratory research with the environment scan of existing software systems in urban transit, the literature review in taxonomy, expert interviews, and study of use cases contributed to the structure of our first classification system to develop to organize our understanding of the existing user interfaces already in use for various urban transit applications.

Users	User tasks (with existing software systems used)	Data Type

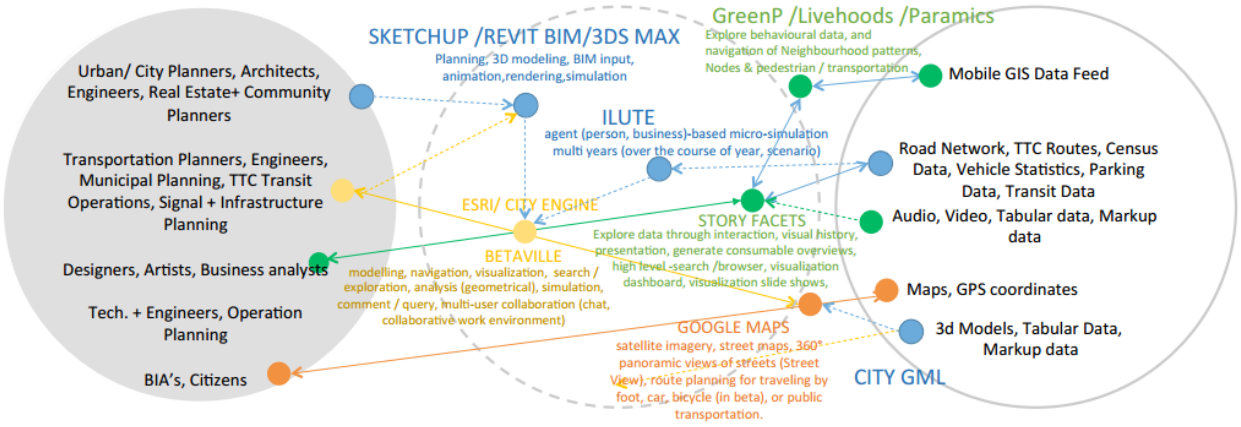

Figure 02: Taxonomy prototype 01

Figure 03: Design workshop to test initial prototype.

We tested this classification system with expert users, to gather feedback in a generative design charrette with a group of transit and traffic management researchers, city planners and designers of urban transit software systems (iCity consoritum industry partners).

This generative exercise and the follow up discussions around taxonomy literature helped us refine our User-centered Taxonomy Prototype 02.

User-centred Taxonomy Prototype 02 (Figure 04)

Based on our survey and research in the urban transportation application systems, we further revised our taxonomy prototype to highlight important elements that contribute in designing urban transportation dashboards.

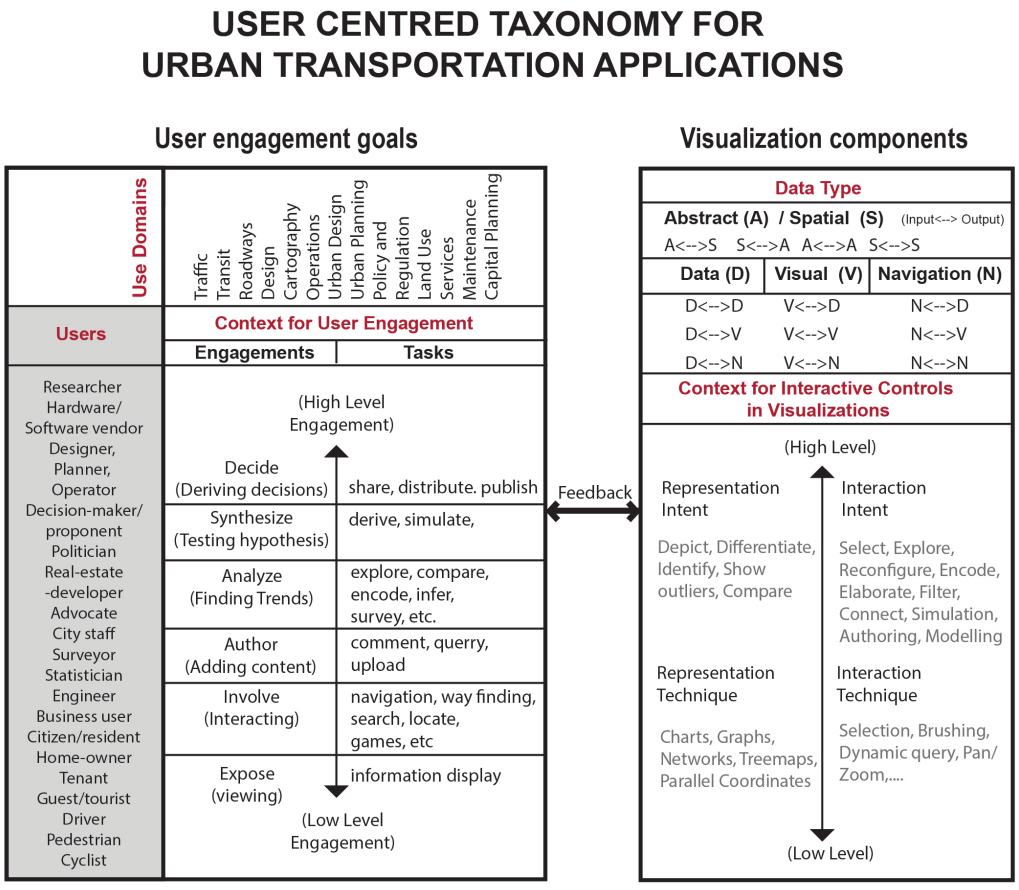

Figure 04: User-Centred Taxonomy for Urban Transportation Applications

Technical / workshop research scope:

We intend to conduct this design workshop as part of our **Evaluative Design research**[1] to test and further develop the prototype User-centred Taxonomy for Urban-Transportation System Visualization

which has emerged from our initial literature review, expert interviews, and feedback from the generative design research session discussed above.

We will share the design process and research findings to date with researchers, designers and developers of software applications system; our research scope for the workshop itself will be while exploring and testing assumptions around the designed taxonomy to supports visualization tools and methods for smart cities

Workshop Format:

The workshop will provide the opportunity to present, discuss, and debate ideas, challenge emerging technologies and project directions towards smart city visualization supports in an interdisciplinary environment. With the focus on utilizing use cases and user stories to test the framework proposed in this taxonomy of visualization which will help the research team outline the design of tools and methods necessary to navigate urban systems.

We will provide examples of software from the taxonomy that meets different users' needs and explain how these were analyzed. Examples include City Engine (ESRI), Betaville and IBM's Watson Analytics. Some of the guiding questions include the following: Where does the use case begin and end with respect to stakeholder technology accessibility? How can this framework be used to study the stakeholder engagement at various stages of design of software applications. What data literacy is needed for various user groups to engage in discussion to co-design? Where will be the trade-offs between accessibility and the privacy of data in an open source urban application system?

The activities will include an initial presentation to establish the context for the workshop, followed by a series of working group discussions. A series of topical probing questions will be provided to encourage discussion and debate, which will be transcribed to be integrated into a “big” picture map of emerging issues.

Activity Breakdown: 90 minutes

Introduction and context: 15 minutes

Key Activity - discussion and debate: 60 minutes
Each group will be provided with a series of probing questions around use cases, and asked to provide opinions and issues around the access, use of technology, and other emerging issues related to navigating smart cities, trade-offs, and economic benefits.

Wrap-up: 15 minutes

Outcomes:

- An understanding of the emerging context of smart cities: impacts and possibilities
- Participants will have the opportunity to exchange ideas with each other and learn about software applications and emerging technologies being currently used in smart cities
- Outline of associated trade-offs, benefits and opportunities of informatics and visualization to support smart cities

- Understand the research approach being used and participate in building further understanding of wider research community.

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