ITcon
www.itcon.org - Journal of Information Technology in Construction - ISSN 1874-4753

# USER EVALUATION OF A SOFTWARE INTERFACE FOR GEOVISUALIZATION AND COMMUNICATION OF UNCERTAIN URBAN ONTOLOGIES

PUBLISHED: February 2010 at http://www.itcon.org/2010/9

EDITORS: Teller J, Billen R, Cutting-Decelle A-F

***H. Ban, Ph.D. Candidate,***
***Department of Geography, The Ohio State University;***
***ban.11@buckeyemail.osu.edu***

***O. Ahlqvist, Assistant Professor,***
***Department of Geography, The Ohio State University;***
***ahlqvist.1@osu.edu***

***SUMMARY:*** *The study aims to evaluate a software interface that is developed for interactive representation and negotiation of spatial concepts of urban ontology terms such as ex-urbanisation to help communication and knowledge sharing between users. We conduct two types of user-evaluation; closed interviews focusing on general aspects of the interface, and in-depth interviews to deal with boundary issues of urban environment between stakeholders. From the result, we find that the software interface could be useful for urban ontology research and land use, with support of different ontologies of different actors for a common concept.*

***KEYWORDS:*** *user evaluation, software interface, communication, ex-urbanisation, urban concept, uncertainty.*

***REFERENCE:*** *Ban H, Ahlqvist O (2010) User evaluation of a software interface for geovisualization and communication of uncertain urban ontologies, Special Issue Bringing Urban Ontologies into Practice, Journal of Information Technology in Construction (ITcon), Vol. 15, pg. 122-131, http://www.itcon.org/2010/9*



## 1. INTRODUCTION

Recently diverse actors including government, stakeholders, and citizens are participating in urban development for better understanding of local social context and environment (Nolmark 2007). Information that different actors would bring into urban planning and design activities could include a wide spectrum from local practical knowledge to general urban theory. The term 'ontology' means a formal, explicit specification of a common understanding of some domain that can be communicated across people and computers (Studer et al. 1998). As public participation in urban decision-making processes is increasing, communication, negotiation, and argumentation between the actors become increasingly important (Teller 2007).

Genesereth and Nilsson (1987) had argued that one of the main goals of applications for ontologies in information sciences is the ability of knowledge sharing and reuse. There have been efforts to improve communication and knowledge-sharing of urban ontologies using developed tools. Some examples tools aim to support representation of conceptual/spatial information of urban ontologies and knowledge in ontology-based models (Ban and Ahlqvist 2008; Cataldo and Rinaldi 2008). Other tools simulate multiple urban-design scenarios to formally represent both implicit and explicit knowledge of ontologies (Caneparo et al. 2008). In addition, a tool for Geo Semantic Web community was developed to support annotation of common interest between multiple users and browsing of information (Marcheggiani et al. 2008).

However, it would be hard to tell how such tools would be useful for dealing with issues of urban ontology in practice unless it is evaluated. For example, Métral et al. (2007) argue that a tool should provide relevant information for each actor that can be easily understood by different user profiles so that they could support "actor-specific ontologies". Also it is important to evaluate the tool and its interface with different urban actors (Métral et al. 2007). One of the reasons for the evaluation is the "paradigms of visualization" that could vary in their usefulness for specific actors, such as people in different age groups (Marcheggiani et al. 2008). In addition, feedbacks from the diverse actors could be helpful to unveil current limitations of a tool and provide better ideas for its improvement.

This paper aims to evaluate an existing tool for communication and knowledge sharing between different actors in urban planning/design activities by interviewing stakeholders from different user groups—i.e., residents, researchers, and policy-making players. Another goal of this study is to see how different types of user-evaluation methods would contribute to evaluate the tool, ultimately to understand how urban ontologies in practice work in the domain of urban development.

Our research on urban ontologies has gone through three research phases. In the first phase, we revealed spatial implications of uncertainty in urban-ontologies terms such as ex-urbanisation using a fuzzy-set approach and geovisualisation techniques (Ban and Ahlqvist 2007). The second phase of our study suggested a web-based software interface 'pinu' (program for identification and negotiation of uncertain concept definitions) developed for interactive visualization, communication, and negotiation of the concept of ex-urbanisation with empirical spatial data (Ban and Ahlqvist 2008). In this paper we report on our findings from the third phase user evaluations of pinu's interface conducted through pilot interviews followed by in-depth interviews using a semi-structured format.

## 2. THEORETIC BACKGROUND

### 2.1 Uncertainty of concepts in urban ontology between actors

Because actors in urban management and policy making are from diverse social groups, have different roles, and come from individual backgrounds, there are potential issues of communication or knowledge sharing. Some of the issues may originate from uncertain aspects of urban ontologies. For instance, a term "ex-urban area" that means "a region between the rural lands that are beyond commuting distance to a metro area and the expanding suburban areas" (Daniels 1999) is sometimes represented by other terms such as "urban sprawl", "periurban area", or "urban-rural fringe" (Weaver and Lawton 2001). However, even when dealing with a same terminology for a concept such as the ex-urbanisation, there can be multiple definitions of the concept (Ban and Ahlqvist 2007; 2008). For instance, one of the existing ex-urban definitions mentioned that the ex-urban area locates "10 to 50 miles (approximately 16 to 80 kilometers) away from a major urban center of at least 500,000 people, or 5 to 30 miles (approximately 8 to 48 kilometers) from a city of at least 50,000 people, generally within 25 minute commuting distance" and the population density is "generally less than 500 people per square mile" (Daniels 1999, chap. 1). Another definition argues that the ex-urban area locates "within 50 miles (approximately 80 kilometers) of the boundary of the central city of a Metropolitan Statistical Area (MSA) with a population of between 500,000 and less than 2 million", or "within 70 miles (approximately 113 kilometers) of the boundary of the central city of an MSA with a population of more than 2 million" (Nelson 1992).

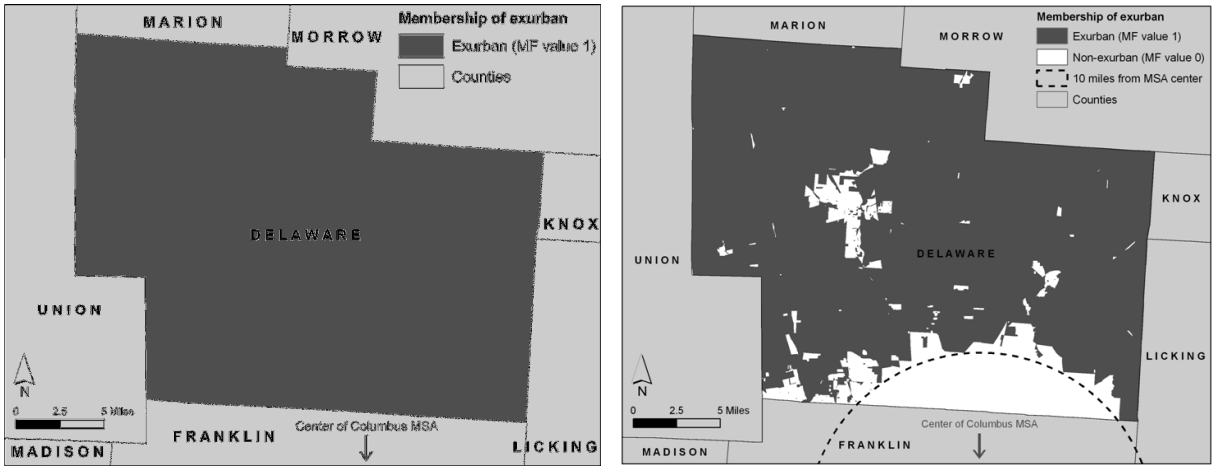
The two example definitions above have attributes such as population and distance, and their measurements indicate that the actual location of the ex-urban area can be different when each definition is represented in an empirical space. Figure 1(a) and Figure 1(b) show an incidence of ex-urban location (in the dark gray color) upon the definitions of Nelson (1992) and Daniels (1999) using empirical spatial and demographic data. Both maps in Figure 1 represent boundaries of ex-urban area in Delaware County, Ohio, U.S.A. based on U.S. Census 2000 data (U.S. Census Bureau 2001) in a block-group unit. A block group generally consists of 600 to 3,000 people, with an optimum size of 1,500 people (U.S. Census Bureau 2001). In Figure 1 the definition of Nelson (1992) represents the entire block groups in the County as an ex-urban area (Figure 1a), whereas the definition of Daniels (1999) also represents some non-exurban block groups (in the white color) in the County (Figure 1b). The different ex-urban boundaries in Figure 1 originate from the difference between the two definitions of Daniels (1999) and Nelson (1992). For instance, Daniels (1999) uses both the distance and the population attributes to define an ex-urban area, whereas Nelson (1992) uses only the population attribute. Due to the difference between the two definitions Daniels (1999) captures heterogeneous spatial patterns of ex-urbanisation (Figure 1b) that Nelson (1992) misses (Figure 1a).

Both of the two definitions have the population attribute since the population of an area may affect on demand and decision to allocation of service facilities such as hospitals (Paquette and Domon 2003; Mulroy 2004). Other

existing ex-urban definitions with more attributes than the population could generate different empirical boundaries from the examples in Figure 1 (see Ban and Ahlqvist 2009 for the details).

Due to the different definitions of urban concepts and their spatial boundaries discussed with an example of ex-urbanisation above, its inherent uncertainties in urban ontologies may lead to difficulties in communication between the actors. Also it could generate inefficiency and confusion in urban management. Especially, in European countries there are important issues such as multilinguality that may affect development of e.g. a European Spatial Data Infrastructure (Nowak et al. 2005).

The decision making of ex-urban boundary can take an important role in land-use since it affects on allocation of existing resources that is directly related to social conflicts. According to Vining and Schroeder (1989) conflicts about decisions of pro-preservation in an ex-urban area were found in their experiment. In the study of land-use planning in urban environment including urban sprawl, Godschalk (2004) noted that a term "Smart Growth" is defined differently by development-oriented groups, environmental groups, and planners/public officials. Due to the uncertainty, Godschalk (2004) mentioned that internal conflicts can exist on the definition, priorities, and implementation strategies of Smart Growth.




*(a)* *(b)*

*FIG. 1: Exurban areas based on (a) Nelson's (1992) definition and (b) Daniels's (1999) definition (Ban and Ahlqvist 2007, Fig 6 and Fig 7)*

Individual residents in a city may have different viewpoints or social conflicts about their quality of life (Budny 2007), and the conflicts can be found over boundary issues of land-use. In case of the United States, according to Brueckner (2000), often policy makers restrict developments in urban fringe by defining areas using a zoning tool called "urban growth boundary" (UGB). However there exist different arguments about the UGB that consider it is "loose" or "stringent" for managing the size of a city (Brueckner 2000). In Israel, borders between urban and rural authorities have been redefined to deal with conflicts over regional industries, property taxes, different religions, services by rural Regional Councils to ex-urban areas (Waterman 2008). In the study of tensions of ordinary people on urban growth without official boundary policies, Cadieux (2008) noted that a flexible urban boundary is necessary to deal with urban sprawl, a mixture of urban and green spaces.

It is therefore essential to have a clear and transparent information exchange about the uncertainty of the urban ontologies between the actors in urban decision-making. Some problems related to these or other types of uncertainty issues could be identified and possibly resolved by evaluating the tools with participation of the actors in practice.

## 2.2 Participatory GIS (PGIS) approach

PGIS aims to promote public participation in policy-making processes by engaging individual citizens, nongovernmental organizations, grassroots groups, and community-based organizations using GIS, such as a spatial decision support system or a web-based municipal GIS (Sieber 2006). GIS's ability to explore spatial data and its visual representations is important in PGIS approaches because some grassroots organizations may use GIS more for "cartographic spatial narratives" than spatial analysis (Elwood 2006).

As PGIS are increasingly being adopted to urban research, qualitative PGIS brings quantitative GIS-methods and qualitative data together to interpret different forms of spatial knowledge from diverse social groups. However, even a PGIS approach may be criticized because the way used ontologies might include particular socio-political

information and embed institutional factors in the spatial data and this in turn might generate uneven access to the GIS (Elwood 2006). When developing software for PGIS such as pinu, evaluating the effectiveness is therefore fundamental to a successful integration of societal goals with local context and objectivity (Sieber 2006; Haklay and Tobon 2003).

## 3. USER EVALUATION DESIGN

Having an existing prototype application, 'pinu' (Ban and Ahlqvist 2008), we developed a pilot-type user testing of pinu in order to see whether its interface supports the intended concept comparison/creation user activities, and to find existing limitations in pinu that could be further developed. The pilot interviews were focused on evaluating overall interface design and provide feedback for potential extensions of the software functionality. After this first round of interviews and revisions we conducted additional in-depth interviews for the purpose of evaluating the revised pinu interface illustrated in Figure 2. These in-depth interviews were focused not only on the interface design and usefulness, but also emphasized how each actor recognized ex-urbanisation and related issues or conflicts.

### 3.1 Designing the pilot interviews

The subjects of the pilot interviews consisted of seven graduate students in the Department of Geography, the Ohio State University, U.S.A. The students were recruited to represent different specializations in geography and to have varying computer/online-map literacy.

In the survey, we showed a cartoon developed for the interviews to inform the interviewees about an example of boundary issues of ex-urbanisation in practice. Then we gave each interviewee a brief presentation about the purpose of the study and basic concepts necessary for the interview. This was followed by a demonstration of the tool with an example scenario (Figure 2). Lastly, after the participants had experienced pinu, we asked the interview questions. The questions include evaluation about the readability, visual design, and usability of components in the interface (see examples in Table 1) that they had looked at and manipulated. The questions were formulated as closed questions in which interviewees are provided with alternative answers such as Yes/No (Parfitt 1997), however the participants could also elaborate freely on the questions during the interview.

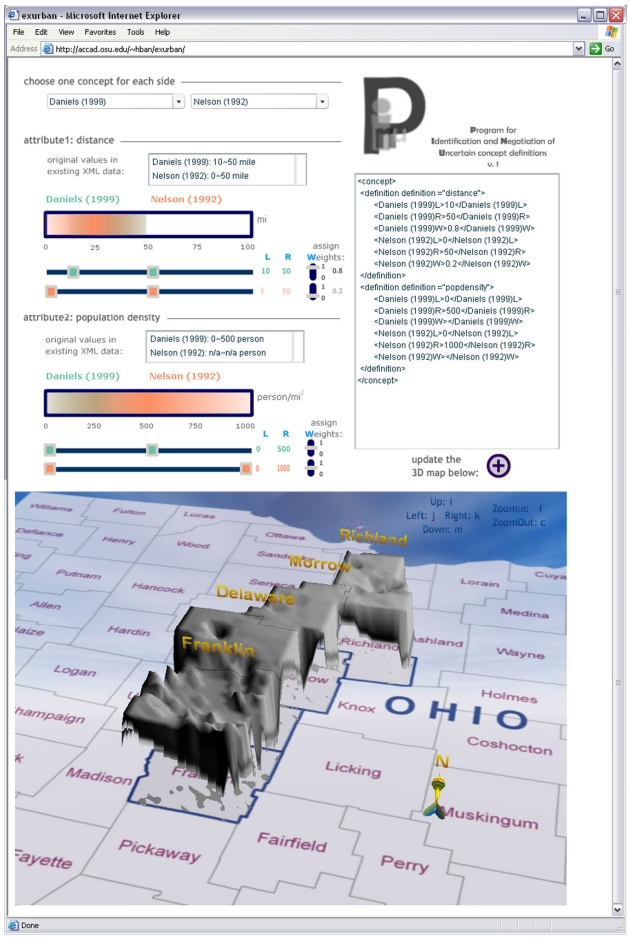


*FIG. 2: pinu used in the pilot-interviews (revised version of Ban and Ahlqvist 2008, Fig 1)*

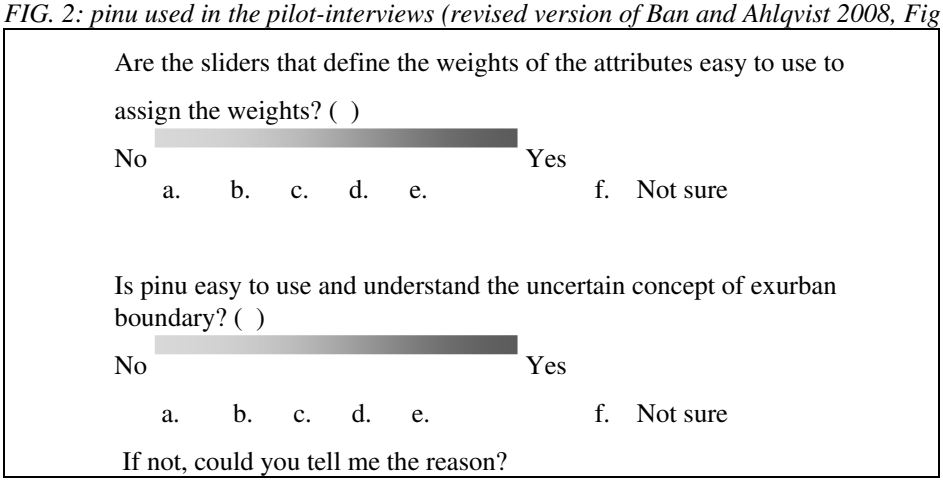



*TABLE. 1: Example of closed questions designed for the pilot interviews*

## 3.2 Designing the in-depth interviews

After the pilot evaluation, the pinu interface went through some revisions based on the user feedback (Figure 3). The in-depth interviews were then designed to focus not only on the tool's interface design and usefulness, but also emphasize how each actor recognize ex-urbanisation and what they feel about issues or conflicts related to the ex-urban boundary. We conducted the in-depth interviews with eleven actors consisting of two residents, two researchers, and seven policy-making players who live in or are related to ex-urbanisation in Delaware County, Ohio, U.S.A. The interviews consisted of both closed and open-ended questionnaires, allowing participants to express their opinion on matters that related to the use of this software (see examples in Table 2). The open-ended questions do not force respondents into particular answers (Parfitt 1997). The questions were designed to gain insights about software such as 1) what the actors find from the software by using it and 2) how they think that the software could be useful to deal with boundary issues of ex-urban area in urban development and management. For six of the policy-making players a group-interview was conducted. During the in-depth interviews, the same procedures of the pilot interviews were used. This time, all responses were voice-recorded under consent of each interviewee when the open-ended questions were asked. On the other hand, in the pilot interviews we recorded all responses onto answering forms that were developed for the interviews.

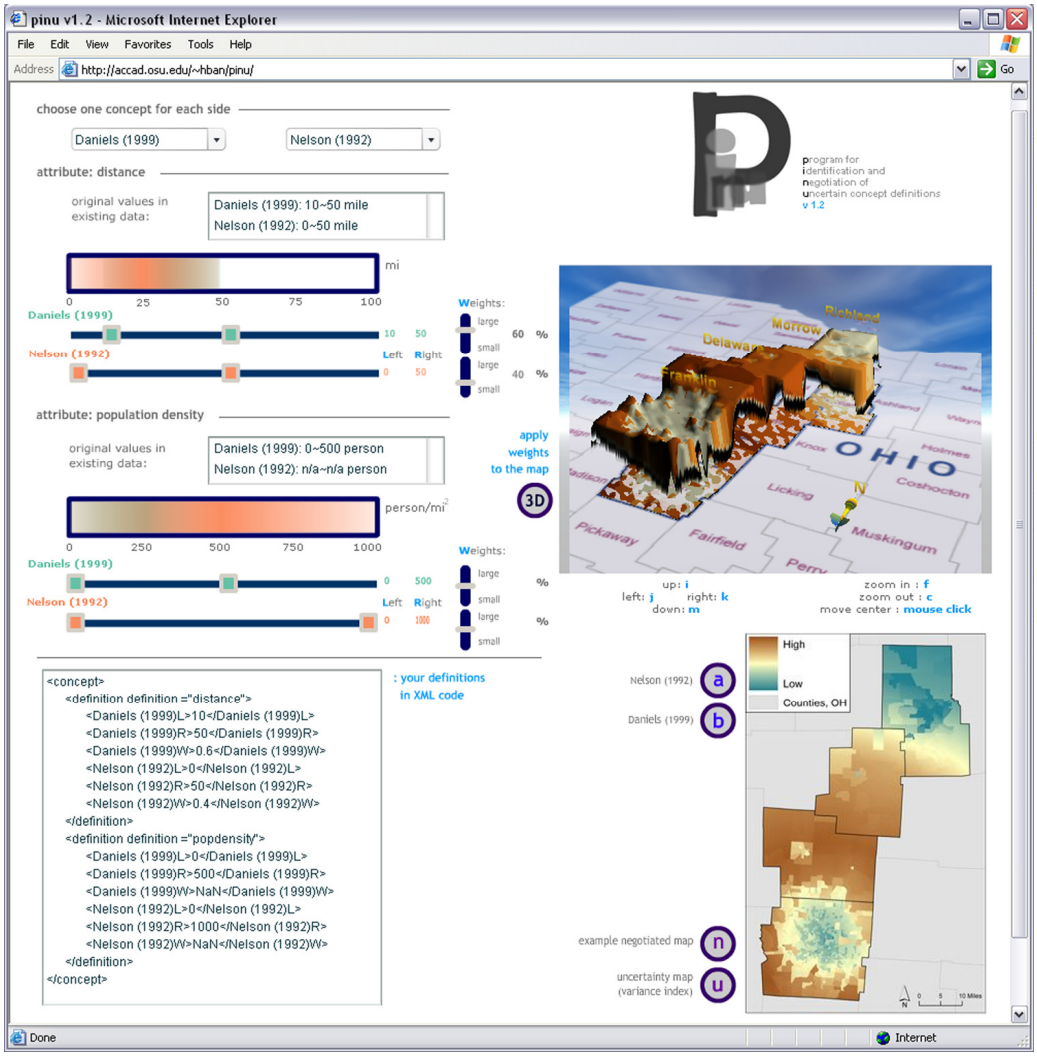



*FIG. 3: pinu's interface used in the in-depth interviews (revised version of Figure 2)*

In Figure3, the interface is revised from previous version of pinu (Figure 2) based on the responses from the pilot interviews. For example, design of some components was relocated and/or resized, the 3D map had classified color schemes, and 2D maps were included for the user's reference and convenience of use.

| |
|---|
| How would you describe an exurban area? |
| Do you know or have you heard about any conflicts associated with the presence of these different types of places—such as areas more urban or more rural—in Delaware County? |
| Do you think something like pinu would be useful for land-use policy making? Why or why not? |
| (follow-up question if positive answer) How do you think you could use a tool like pinu in your work related to land-use policy making? |

*TABLE. 2: Example of open questions designed for the in-depth interviews*

## 4. RESULTS

### 4.1 Pilot interviews with general actors

As general remarks on the interface design, the participants recommended changes for the size, position, colors, and transparencies of the rectangular bars, sliders, and texts for better readability and manipulation. The

interviewees also pointed out a need for multiple color schemes on the 3D object in the map (Figure 2), more landmark objects in the study area, two types of views of the spatial data in 2D and 3D. The participants also expressed an interest to explore and negotiate multiple ex-urban definitions to build their own understanding with the empirical data.

## 4.2 In-depth interviews with focused actors

The in-depth interviews provided much feedback on the revised interface and their thinking about the ex-urban concept. All participants seemed to agree that the concept is uncertain and difficult to define. For instance, actors in the resident group were not aware of the term 'ex-urbanisation' or its exact meaning. Due to this limitation of knowledge, they tried to deal with the boundary issues of ex-urban area based on their experiences and knowledge of their home environment.

Asked about what they recognize from visualization of uncertain boundary of ex-urban area provided by pinu, all eleven interviewees responded that they realized the uncertainty. For questions about pinu's usefulness for communication and knowledge sharing, most of them responded positively and mentioned that they would use a tool like pinu. Related to this, all of them suggested they would prefer if the tool could include more concepts with definitions since additional definitions may provide a better sense of the ex-urban boundary through empirical examples.

For enhancement of the interface, most of the interviewees suggested changes in some part of the interface such as size of the sliders and texts would for easier use. Specifically, the resident-interviewees suggested developing another tool that could support representation and negotiation for planning and design of their home environment with other actors such as their neighbors. The researcher-interviewees recommended expanding the representation of ex-urban area by including more dimensions such as temporal change of ex-urban boundary. The policy-making players responded that pinu's visualization and negotiation functionalities would be useful for land-use management with multiple stakeholders. The interviewees also suggested the potential to use pinu to deal with other issues of urban development that local agencies and actors need to deal with.

Some interviewees pointed out that there have been conflicts over certain types of boundary in ex-urban areas in their real life. For example, three interviewees mentioned that one of the shopping centers located in ex-urban areas in City of Powell in Delaware County covers other ex-urban areas in nearby cities as well, and some shared social amenities between the cities have been allocated within the shopping center. However due to the difference between the existing administrative boundaries and the service boundary of the shopping center there have been conflicts between Powell and the other cities. Similarly, one of the post offices in ex-urban areas in Powell has been covered other ex-urban areas in nearby cities as well. However, since actual addresses of the residents in the nearby cities are not inside of Powell, there have been issues on the location of the post office between the residents.

The responses from the in-depth interviews also indicated that even actors in the same social group may have issues of communication regarding urban ontologies. For instance, both of the two resident interviewees responded that people do not move to ex-urban areas only for their interests such as financial advantage they may earn in the ex-urban areas. At the same time, one of the resident interviewees used some characteristics of ex-urban area to describe suburban area.

Based on the responses from the pilot interviews, the interface revised in Figure 4 supports access to remote concept-definition resources. The re-developed interface thus includes more interactivity, enhanced usability, and interoperability. In addition, the user could create a new concept definition and visualize that together with existing definitions and empirical spatial data using the interface in Figure 4.


*FIG. 4: Example of future version of pinu's interface (Ban and Ahlqvist 2009, Fig 4)*

## 5. CONCLUDING DISCUSSION

This paper provided user-evaluations of a software interface developed for representation, communication, and negotiation of urban ontologies. A series of revisions of the software-interface based on the evaluations was shown in Figures 2, 3, and 4. This study also demonstrated the following results: first, the evaluated software interface, pinu, is potentially useful for participation, communication, knowledge sharing, and conflict resolution between actors in the domain of urban planning. According to the results of the evaluation, interactive-visualization functionality along with the user's manipulation was one of the strengths of the software interface. In future work the tool could be extended to include broader functionality such as Parallel Coordinate Plots (Inselberg 1985) that are useful for visualization of relationship(s) between records in the data. Figure 4 suggests another possibility of future developments of pinu's interface that supports original-concept creation by users, multiple choices of concept and data, and complementary use of 2-dimensional and 3-dimensional geovisualization (Ban and Ahlqvist 2009). To deal with qualitative data related to urban environment, analysis of multiple sources of data such as images of a certain place or movies showing narratives by actors for such a place would be useful for richer local information (Kwan and Ding 2008). Other functionalities such as metadata management by the users in Semantic Wiki could be considered (Krötzsch et al. 2005; Auer et al. 2006; Hepp et al. 2006).

In terms of methodology, we found that the two types of interviews conducted in this study were useful for specific questions being asked. For instance, the pilot interviews with closed questions were useful for measuring qualitative responses using multiple, but continuous choices (Table 1). When the interviewees had to answer some qualitative questions—such as "Is pinu easy to use and understand the uncertain concept of exurban boundary?"—they responded that the multiple choices showing the corresponding, continuous degrees between Yes and No in a continuous grayscale between dark gray and light gray provided them some guidelines to select an answer. On the other hand, the open-ended questions in the in-depth interviews were helpful to capture elastic flow of thinking and responding of the interviewees that was not frequently following simple linear order of answering for the questions. For example, some interviewees provided answers for a question asked as well as

questions that will be asked later. Or, some following questions that were unplanned before the interview shed light on some responses for other questions.

For even more insight, more actors from various social groups such as land developers from private sectors in urban planning could be interviewed, and diverse focus-group meetings could be conducted for the evaluation of the tool. Clearly, user evaluations are an important instrument to provide for better design and our evaluations, albeit small and partial, provided many informative answers and helped improve our work. Due to heterogeneous regional characteristics in urban environment, it is difficult to establish a common ex-urban definition for all areas. However, further user evaluations might be helpful to find better definitions of ex-urbanisation than other definitions for certain areas.

## 6. REFERENCES


Auer, S., Dietzold, S., and Riechert, T. (2006). The Semantic Web - ISWC 2006, *Proceedings of 5th International Semantic Web Conference*, ISWC, http://www.informatik.uni-leipzig.de/~auer/publication/ontowiki.pdf.

Ban, H. and Ahlqvist, O. (2007). Visualizing the Uncertainty of Urban Ontology Terms, *Studies in Computational Intelligence: Ontologies for Urban Development*, Vol. 61, 85-94.

Ban, H. and Ahlqvist, O. (2008). Web-based Interactive Visualization of Uncertain Concepts in Urban Ontologies, In: Teller, J., Tweed, C., Rabino, G. (eds.): *Conceptual Models for Urban Practitioners*, Società Editrice Esculapio, Bologna, 57-68.

Ban, H. and Ahlqvist, O. (2009). Representing and Negotiating Uncertain Geospatial Concepts - Where are the exurban areas?, *Computers, Environment and Urban Systems*, Vol. 33, 233-246, doi:10.1016/j.compenvurbsys.2008.10.001.

Brueckner, J.K. (2000). Urban sprawl: Diagnosis and remedies, *International Regional Science Review*, Vol. 23, 160-171.

Budny, D.N. (2007). Democracy and the city: Assessing urban policy in Brazil, *Comparative Urban Studies Project*, Vol. August 2007, Woodrow Wilson International Center for Scholars, 1-5, http://www.wilsoncenter.org/topics/pubs/cusp.brazil.web.pdf.

Cadieux, K.V. (2008). Political ecology of exurban ‘‘lifestyle’’ landscapes at Christchurch’s contested urban fence, *Urban Forestry & Urban Greening*, Vol. 7, 183–194.

Caneparo, L., Collo, M., di Giannantonio, D., Lombardo, V., Montuori, A., and Pensa, S. (2008). Generating Urban Morphologies from Ontologies, In: Teller, J., Tweed, C., Rabino, G. (eds.): *Conceptual Models for Urban Practitioners*, Società Editrice Esculapio, Bologna, 171-184.

Cataldo, A. and Rinaldi, A. (2008). Using an Ontology-based Model for Knowledge Representation in Rural Landscape, In: Teller, J., Tweed, C., Rabino, G. (eds.): *Conceptual Models for Urban Practitioners*, Società Editrice Esculapio, Bologna, 133-148.

Daniels, T. (1999). *When City and Country Collide*, Island Press, Washington, DC., Ch. 1.

Elwood, S. (2006). Critical issues in participating GIS: Deconstruction, reconstructions, and new research directions, *Transactions in GIS*, Vol. 10, No. 5, 693-708.

Genesereth M.R. and Nilsson N.J. (1987). *Logical foundations of artificial intelligence*, M.Kaufmann Pub., Los Altos (CA, U.S.A.).

Godschalk, D.R. (2004). Land Use Planning Challenges- Coping with Conflicts in Visions of Sustainable Development and Livable Communities, *Journal of the American Planning Association*, Vol. 70, No. 1, 5-13.

Haklay, M. and Tobon, C. (2003). Usability evaluation and PPGIS: towards a user-centred design approach, *International Journal of Geographical Information Science*, Vol. 17, No. 6, 577–592.

Hepp, M., Bachlechner, D., and Siorpaes, K. (2006). OntoWiki: community-driven ontology engineering and ontology usage based on Wikis, International Symposium on Wikis, In: *Proceedings of the 2006 international symposium on Wikis*, Odense, Denmark, 143 – 144.

Inselberg, A. (1985). The plane with parallel coordinates, *Visual Comput*, Vol. 1, 69–97.

Krötzsch, M., Vr, D., and Völkel, M. (2005). Wikipedia and the Semantic Web - The Missing Links, *Proceedings of Wikimania 2005*, http://www.aifb.uni-karlsruhe.de/WBS/mak/pub/wikimania.pdf.

Kwan, M.-P. and Ding, G. (2008). Geo-Narrative: Extending Geographic Information Systems for Narrative Analysis in Qualitative and Mixed-Method Research, *The Professional Geographer*, Vol. 60, No. 4, 443-465.

Marcheggiani, E., Nucci, M., Tummarello, G., and Christian, M. (2008). Geo Semantic Web Communities for Rational Use of Landscape Resources, In: Teller, J., Tweed, C., Rabino, G. (eds.): *Conceptual Models for Urban Practitioners*, Società Editrice Esculapio, Bologna, 107-120.

Métral, C.,Falquet, G., and Vonlanthen, M. (2007). An Ontology-based Model for Urban Planning Communication, *Studies in Computational Intelligence (SCI)*, Vol. 61, 61–72.

Mulroy, E.A. (2004). Theoretical Perspectives on the Social Environment to Guide Management and Community Practice: An Organization-in-Environment Approach, *Administration in Social Work*, Vol. 28, No. 1, 77-96.

Nelson, A.C. (1992). Characterizing Exurbia, *Journal of Planning Literature*, Vol. 6, No. 4, 350-368.

Nolmark, H. (2007). COST Action C20 Urban Knowledge Arena: Cross-boundary Knowledge and Know-how on Complex Urban Problems, *Studies in Computational Intelligence (SCI)*, Vol. 61, 15–25.

Nowak, J., Peedell, S., and Nogueras-Iso, J. (2005). Issues Of Multilinguality In Creating A European SDI – The Perspective For Spatial Data Interoperability, In: *Proceedings of the 11th EC GI & GIS Workshop, ESDI Setting the Framework*, Alghero, Sardinia, Italia.

Paquette, S. and Domon, G. (2003). Changing ruralities, changing landscapes:exploring social recomposition using a multi-scale approach, *Journal of Rural Studies*, Vol. 19, 425–444.

Parfitt, J. (1997). Questionnaire design and sampling, In: Flowerdew, R.; Martin, D., eds. *Methods in human geography: a guide for students doing a research project*, Addison Wesley Longman Limited, Essex, England, 76–109.

Sieber, R. (2006). Public Participation Geographic Information Systems: A literature review and framework, *Annals of the Association of American Geographers*, Vol. 96, No. 3, 491–507.

Studer, R., Benjamins, V. R., and Fensel, D. (1998). Knowledge Engineering: Principles and Methods, *Data and Knowledge Engineering*, Vol. 25, No. 1-2, 161-197.

Teller, J. (2007). Ontologies for an Improved Communication in Urban Development Projects, *Studies in Computational Intelligence (SCI)*, Vol. 61, 1–14.

U.S. Census Bureau (2001). Census 2000 Summary File 1 Technical Documentation, *U.S. Census Bureau*, Washington, D.C., U.S.A.

Vining, J. and Schroeder, H.W. (1989). The Effects of Perceived Conflict, Resource Scarcity, and Information Bias on Emotions and Environmental Decisions, *Environmental Management*, Vol. 13, No. 2, 199-206.

Waterman, S. (2008). Constructing Spatial Knowledge: Geography as a Discipline: A Critical Overview of the Evolution of Israeli Human Geography, *Israel Studies*, Vol. 13.1, 20-43.

Weaver, D. and Lawton, L. (2001). Resident Perceptions in the Urban–Rural Fringe, *Annals of Tourism Research*, Vol. 28, No. 2, 439-458.

*This paper is avaliable electronically at http://itcon.fagg.uni-lj.si/~itcon/index.htm*