Case Study – Invited Talk

Developing and Applying UrbanSim, a System for Simulating Urban Land Use, Transportation, and Environmental Impacts

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Overview

In this case study, we provide a brief overview of the UrbanSim project and its history, and then suggest some reasons that we believe the project has been successful so far.

UrbanSim is a tool for use by urban planners and others to help predict future patterns of urban development under different possible input scenarios, over periods of twenty or more years. It should support deliberation and debate on such issues as building new transit systems or freeways, or changing zoning or economic incentives, as well as on broader issues such as sustainable, livable cities, economic vitality, social equity, and environmental preservation. We want stakeholders to be able to consider different scenarios – packages of possible policies and investments – and then, based on these alternatives, model the resulting patterns of urban growth and redevelopment, of transportation usage, and of resource consumption and other environmental impacts.

The first prototype version was developed in 1996 to provide a land use model to aid in planning activities in Honolulu, Hawaii; it was then applied, again in prototype form, to Eugene/Springfield, Oregon in 1998. Version 1 of the software was released in 2000, and subsequently applied to Salt Lake City, Utah. Application to Houston, Texas began in 2001. Starting in summer 2002, we rewrote the software from the ground up, with the release of Version 2.0 later that year. Also in 2002, we set up a partnership with the Puget Sound Regional Council (the Metropolitan Planning Organization for the region that includes Seattle) to further develop UrbanSim and apply it locally, with the intent of making it the operational land use model for the region. Finally, in 2003, the University of Washington approved the formation of a new Center, the Center for Urban Simulation and Policy Analysis, to provide a formal organizational home for the interdisciplinary effort. The project has received funding under the Digital Government program (as well as the NSF ITR program) beginning in September 2001. We also received matching

funds from the Federal Highway Administration, which are being used to support a case study of applying UrbanSim in the Salt Lake City region, including an evaluation by an expert External Review Panel.

Regarding the success of the project, we should first note that the project has been successful so far (in setting up partnerships with local and regional government agencies, in producing an operational urban model that is considerably more advanced than others in routine use, and in setting up a highly interdisciplinary collaboration in the university). However, the long-term success of the project should be judged on whether we produce a software system that is in routine, day-to-day planning use by Metropolitan Planning Organizations and others, and that – ultimately – changes for the better the way urban planning is done. Here the jury is still out. In outline form, here are some reasons that we believe the project has been successful so far:

- Most importantly, we identified real, unmet needs of local and regional governments and are developing a system to meet those needs. The land use models that most agencies currently use are quite inadequate to meet the demands and expectations placed on them. Drawing on the work of various researchers, we identified public policies of interest. We then developed models to examine the potential effects of these policies, using a behavioral framework that accounts for the interactions of policies and markets. This approach has led to models that are more detailed than prior models, which has added computational and data requirements, but has yielded a more understandable and relevant system.
- We set up and are running an interdisciplinary project that has participation from a wide range of University of Washington schools and departments, including the Evans School of Public Affairs, Computer Science and Engineering, Urban Design and Planning, Civil Engineering, the Information School, Psychology, Statistics, and others. Both the Evans School and Urban Design and Planning have many years of experience in setting up successful collaborations with local and state government. The project itself has requirements for expertise that any single one of the participating departments would be unable to meet on its own. To foster collaboration, it has been important to find space that allows project faculty, staff, and students from the different departments to be co-located, and to have frequent meetings and informal discussions among project members from multiple disciplines. We have also had a series of interdisciplinary seminars, and are currently co-teaching a graduate course in urban simulation, with students from a range of departments.
- We have found ways of balancing the research agendas of the respective academic partners with the more applied research needs of governmental partners, by framing the research agenda in problem-centered terms, and tackling problems that are difficult enough to provide motivating research challenges within each of the contributing disciplines.
- We use an agile software development methodology, which allows us to adapt rapidly to changing requirements [3].
- To increase confidence in the reliability of the system, we use an extensive testing methodology. For the same reason, we also strive to write the code clearly enough that the technical modelers, as well as the software developers, can read

and critique the code that implements the core of the component models of UrbanSim.

- To ensure that the system will continue to be available and maintainable, and to allow different users to build on each other's work, we use an open source license for our software, the GNU Public License. Anyone can download the system from our website (including source code, documentation, and tutorials). For example, groups in Paris, France and Taipei, Taiwan are working on applying UrbanSim in those regions. By placing the software under the GPL, rather than simply putting it in the public domain, we help put in place a structure that allows users to build on each other's work. (In contrast, in other cases, land use or transportation modeling software was initially funded by federal or other government agencies and placed in the public domain. It was then modified by a consultancy and made proprietary.) There is still ample opportunity for consultancies to use the software in a service-oriented business model.
- We were able to hire two professional software engineers, with extensive industrial experience, to manage and form the backbone of our programming effort. These engineers also coordinate the work of undergraduate and graduate students who write parts of the software system. The graduate students work on programming projects that form part of their own research efforts as well as contributing to the overall project objectives. A set of undergraduate research assistants, majoring in computer science or computer engineering, make important contributions to the project, as well as gaining valuable experience working with skilled professional engineers on a complex software system. This structure has proven useful in achieving the software quality, reliability, and maintainability that we require.
- The domain of urban development and environmental impacts is value-laden, with different stakeholders often bringing a range of strongly-held and sometimes incompatible values to the table. To handle the design questions raised by this diverse set of values and value conflicts, we use Value Sensitive Design [4], a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process.
- Our research questions are driven first by the requirements of the domain and of delivering a useful, reliable system. (References [2] and [6] are examples of domain research of this kind.) In addition, we have had success doing research that involves studying the methodologies and processes that we use, e.g. [3] on our software development methodology, [1] on a group coordination technique that evolved from the software developers and spread to the rest of the group as well, and [4] on the Value Sensitive Design methodology – we are both applying this methodology to UrbanSim, and also extending it based on the novel aspects of the domain.

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References

All papers in this bibliography are available from www.urbansim.org/papers. This reference list is intended to support the discussion in this case study, rather than to provide a comprehensive set of references to the field of land use and transportation modeling. For such references, as well as an overview of the field, see reference [7].

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[2] Joel Franklin, Paul Waddell, and John Britting, "Sensitivity Analysis Approach for an Integrated Land Development & Travel Demand Modeling System," Presented at the Association of Collegiate Schools of Planning 44th Annual Conference, November 21-24, 2002, Baltimore, MD.

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