Designing for Human Values in an Urban Simulation System: Value Sensitive Design and Participatory Design

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ABSTRACT

UrbanSim is a large-scale simulation system that models the development of urban areas over periods of 20 or more years. Its purpose is to help citizens and local governments make more informed decisions about major transportation and land use issues, by projecting the long-term consequences of the different alternatives. Citizens often bring strongly held values to such decisions, for example regarding equity, sustainability, environmental protection, economic expansion, or property rights, and the decisions are often politically charged. To help shape the design of UrbanSim to better support the democratic process, as well as to be responsive to the values held by different stakeholders and the conflicts among them, we are using Value Sensitive Design, a theoretically grounded approach to the design of technology that seeks to account for human values in a principled and comprehensive manner throughout the design process. Participatory Design also has a good deal to say about these issues. Thus, in this paper, we first describe UrbanSim and Value Sensitive Design, and provide a snapshot of our ongoing work in this area. We then use the UrbanSim work as an example to bring out key commonalities and differences between Value Sensitive Design and Participatory Design, and to motivate some preliminary ideas about ways in which each methodology could evolve based on techniques and concepts from the other.

Keywords

Value Sensitive Design, Participatory Design, design methods, ethics, human values, urban simulation, UrbanSim.

1. THE URBANSIM PROJECT

In many regions in the United States (and globally), there is increasing concern about pollution, traffic jams, resource consumption, loss of open space, loss of coherent community, lack of sustainability, and unchecked sprawl. Elected officials, planners, and citizens in urban areas grapple with these difficult issues as they develop and evaluate alternatives for such decisions as building a new rail line or freeway, establishing an urban growth boundary, or changing incentives or taxes. These decisions interact in complex ways. There are both legal and common sense reasons to try to understand the long-term consequences of these interactions and decisions. Unfortunately, the need for this understanding far outstrips the capability of the analytic tools used in current practice.

In response to this need, we have been developing UrbanSim, a sophisticated, reusable simulation package for predicting patterns of urban development for periods of twenty years or more, under different possible scenarios [10], [11]. Its primary purpose is to provide urban planners and other stakeholders with tools to aid in more informed decision-making, with a secondary goal to support further democratization of the planning process. When provided with different scenarios – packages of possible policies and investments – UrbanSim models the resulting patterns of urban growth and redevelopment, of transportation usage, and of resource consumption and other environmental impacts.

To date, UrbanSim has been applied in the metropolitan regions in the U.S.: around Eugene/Springfield, Oregon, Honolulu, Hawaii, Salt Lake City, Utah, and Houston, Texas, with application to the Puget Sound region in Washington State under way. In each of these applications we worked closely with the Metropolitan Planning Organization for that region. (In the U.S., these MPO's are by federal law in charge of doing regional transportation and land use planning.) The software is licensed under the GNU Public License, and can be freely downloaded from the project website at www.urbansim.org. As a result, other groups have been actively applying the system to their own regions, including efforts in Paris, France, and Taipei, Taiwan.

In its current form, UrbanSim is intended for use by expert modelers at MPO's and other organizations; the results of simulations are then made available to elected officials, interested citizens, and others. In the future, we also plan to provide a web-based interface that will let any interested user inspect simulation results directly and experiment with alternate scenarios.

2. OVERVIEW OF VALUE SENSITIVE DESIGN

We assume that readers of this paper are familiar with Participatory Design. (See for example references [1]and [5] for seminal work in PD, as well as the proceedings of the Participatory Design Conferences for more recent work.) However, readers may not be familiar with Value Sensitive Design (VSD), a considerably newer and less well-known methodology, and so we provide a summary here.

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Value Sensitive Design [2], [3] is a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process. It employs a tripartite methodology, consisting of conceptual, empirical, and technical investigations. These diverse techniques are applied iteratively and integratively, so that the results of the different investigations build on each other.

Conceptual investigations include the careful consideration of which stakeholders are affected by the system (both directly and indirectly), how they might be affected, which values are implicated, and what kinds of value tradeoffs arise. Conceptual investigations also include developing working definitions of the values of interest, drawing on work in philosophy and ethics.

Empirical investigations concern the human context in which the technical artifact is situated, for example, verifying or expanding the list of stakeholders initially identified as affected by the system, or evaluating the success of a particular design. Empirical investigations can be applied to any human activity that can be observed, measured, or documented. Thus, the entire range of quantitative and qualitative methods used in social science research is potentially applicable here, including observations, interviews, surveys, experimental manipulations, collection of relevant documents, and measurements of user behavior and human physiology.

Technical investigations focus on the technology itself. There are two forms of technical investigation. In the first, technical investigations focus on how *existing* technological properties and underlying mechanisms support or hinder human values. In the second, technical investigations involve the *proactive* design of systems to support values identified in the conceptual investtigation.

A hallmark of Value Sensitive Design is that both *direct* and *indirect* stakeholders should be considered in the design of the system. Direct stakeholders are those who interact with the system directly. (Traditional user-centered design focuses on this category of stakeholder.) Indirect stakeholders are people who may be affected (perhaps strongly) by the system, but who do not use it directly. For example, in designing a hospital patient chart system, the direct stakeholders might include doctors, nurses, and other health care workers; the indirect stakeholders would include the patients and their families.

3. APPLYING VALUE SENSITIVE DESIGN TO URBANSIM

In this section, we give a snapshot of our ongoing work on applying Value Sensitive Design to UrbanSim.

3.1 Conceptual Investigations

The direct stakeholders for UrbanSim in its current form are the staff and elected officials at regional and local planning organizations: these are the people who will run UrbanSim or directly use its outputs. The indirect stakeholders are people who are affected by UrbanSim and the decisions it informs, and include elected officials and staff at other government organizations, businesses, workers, advocacy groups, neighborhood associations, as well as the people who live or work in the region. (Note that a given person will often be a member of more than one stakeholder group, for example, both a government staff member and a resident of the region.)

Land use and transportation decisions are often contentious, with stakeholders bringing to the table widely divergent values about environmental, political, moral, and personal issues. These decisions are also embedded in a particular political and social context. How should UrbanSim seek to place itself in this milieu? In particular, how should it handle the wide range of values important to different stakeholders, and the value conflicts among the stakeholders?

In our conceptual investigations, a key initial move was to distinguish between *explicitly supported values* (i.e., ones that we explicitly want to embed in the simulation) and *stakeholder values* (i.e., ones that are important to some but not necessarily all of the stakeholders). Examples of stakeholder values are environmental sustainability, walkable neighborhoods, space for business expansion, affordable housing, freight mobility, minimal government intervention, minimal commute time, open space preservation, property rights, and environmental justice.

Next, we committed to three specific moral values to be supported explicitly. One is fairness, and more specifically freedom from bias. The simulation should not discriminate unfairly against any group of stakeholders, or privilege one mode of transportation or policy over another. A second is accountability. Insofar as possible, stakeholders should be able to confirm that their values are reflected in the simulation, evaluate and judge its validity, and develop an appropriate level of confidence in its output. The third is democracy. The simulation should support the democratic process in the context of land use, transportation, and environmental planning. In turn, as part of supporting the democratic process, we decided that the model should not *a priori* favor or rule out any given set of stakeholder values, but instead, should allow different stakeholders to articulate the values that are most important to them, and evaluate the alternatives in light of these values.

3.2 Technical Investigations

To connect stakeholder values with the output of the simulation, we seek to identify and provide suitable *indicators* [4] that distill some attribute of interest about the results of the simulation, and that speak to the values of concern. (Examples of indicators for this domain might be the number of acres of rural land converted to urban use each year, an index of poverty segregation, or the mode share among autos, transit, bicycles, and walking.) On the input side, we need to provide ways to describe and to simulate different policies and public investments of interest.

Most of the technical choices in the design of the UrbanSim software are in response to the need to generate indicators and other evaluation measures that respond to different strongly-held stakeholder values, and to represent and simulate different policies and public investments of interest. For example, for some stakeholders, walkable, pedestrian-friendly neighborhoods are very important. But being able to model walking as a transportation mode makes difficult demands on the underlying simulation, requiring a finer-grained spatial scale than is needed for modeling automobile transportation alone. In turn, being able to answer questions about walking as a transportation mode is important for two explicitly supported values: fairness (not to privilege one transportation mode over another), and democracy

(being able to answer questions about a value that is important to a significant number of stakeholders).

The development of UrbanSim is being done with substantial participation by the Metropolitan Planning Organizations who are our direct users, including ongoing informal design discussions, more formal presentations, and workshops. There is also an active users' email list. The software is modular and configurable, allowing it to be applied to different regions and circumstances. It is also licensed under the GNU Public License, providing an important mechanism for allowing users to build on each other's work, as well as supporting the values of openness and accountability.

3.3 Empirical Investigations

Most of our empirical investigations so far have drawn on relevant literature describing empirical work on land use, transportation, and sustainability. For example, there is a rich body of work on community indicators for sustainability [6],[8]. These indicator projects have often been highly participatory – for example, the indicators selected by the Sustainable Seattle project [9] were developed with input and participation by hundreds of residents.

Later this year we plan to undertake direct empirical investigations as well, using semi-structured interviews with people from a representative set of stakeholder groups. This empirical work will focus on three particular topics: the full range of stakeholder values and indicators for them (to provide empirical verification and extension of our current list); bias and credibility in UrbanSim; and a more in-depth investigation of one particular value, namely walkability.

4. COMPARING VALUE SENSITIVE DESIGN AND PARTICIPATORY DESIGN

There are a considerable number of commonalities between Value Sensitive Design and Participatory Design. Most importantly, both have a substantive focus on human values and ethics, and not simply on usability. For the purposes of this short paper and audience, however, the differences are perhaps more interesting, and so we now turn to those, using our ongoing work on UrbanSim as a source of examples. We also include a few preliminary ideas on ways in which each methodology could evolve, based on techniques and concepts from the other

4.1 Historical context

Participatory Design was of course developed in Scandinavia in the 1970s and 80s. A legal framework (the co-determination laws), along with a relatively homogeneous culture, shared values, and egalitarian orientation, formed a fertile soil in which PD could take root. There has been considerable thought and effort given to employing PD in places other than Scandinavia, with arguably mixed results. For example, many of the specific techniques originally developed in the Participatory Design work, such as low-fidelity prototypes, are now widely used and accepted as part of standard HCI methodology; but the moral and political commitments of Participatory Design to workplace democracy and equalization of power are often dropped.

While Value Sensitive Design was initially developed in the U.S., the intent from the start has been to develop a methodology of general utility. To date, though, it has mostly been used in U.S. projects. Indeed, some Scandinavians have commented that it has an American flavor to it – perhaps because part of the methodology is explicitly examining values in a system. (In Scandinavia, perhaps it's more likely that the underlying values, such as participation, democratization, and expression of self, would be taken as given, and not discussed so explicitly in the design process.)

4.2 Intended Context of Application

Participatory Design was originally developed in the context of a single organization, often for custom-written software, or for a group of organizations all in the same overall business (as with the Utopia project). It has more recently been applied to other contexts. In contrast, Value Sensitive Design from the start has been intended for application in a variety of contexts: the workplace, home, school, public life, and elsewhere.

In its current form, UrbanSim is intended for use within a group of organizations (Metropolitan Planning Organizations) that perform similar functions in different regions. However, the results of the simulations will presumably be much more widely disseminated in reports, studies, and the like. The situation will become more complex when we also provide web-based stakeholder interfaces to UrbanSim, which will allow a variety of stakeholders (businesses, members of advocacy groups, interested citizens) to interact directly with the system and its outputs.

4.3 Stakeholders to be Considered

Traditionally, Participatory Design considers the workers and management within the organization for which the system is being developed. In contrast, Value Sensitive Design explicitly considers indirect as well as direct stakeholders. For UrbanSim, PD would consider the relevant stakeholders to be the workers, management, and elected officials at the Metropolitan Planning Organizations. VSD would broaden the group to include indirect stakeholders, including members of advocacy groups, neighborhood associations, and residents and voters. PD, as its theory and practice has evolved, often includes additional stakeholders. However, we suggest that the explicit, principled inclusion of both direct and indirect stakeholders, from the start, is a valuable contribution of VSD.

A problem for VSD, however, is that the number and different kinds of stakeholders can grow unmanageably large. In the UrbanSim case, for example, since land use and transportation decisions in a region have a direct effect on that region's greenhouse gas production, we could view every person on the globe, as well as every member of future generations, to be a stakeholder. Further, these people will be affected in different ways and to different degrees (e.g., people living in low-lying coastal areas vs. in the mountains.) Thus, for pragmatic reasons, we need to consider how strongly the different classes of indirect stakeholders are affected, and at some point draw the line and not consider all of them, at least with the same degree of thoroughness.

Even after drawing such a line, doing a complete empirical investigation may still be prohibitive, particularly when VSD is used in fast-moving situations such as product development. For this reason, we are currently developing a more streamlined set of techniques – Discount VSD – in analogy with Discount Usability [7]. Full VSD will be useful in situations such as establishing

value findings in the scientific literature, for making them available for defensible, solid reuse by practitioners, or for establishing credibility when doing complex or controversial design projects. By contrast, Discount VSD will be useful to inform design, rather than (for example) to establish statistically significant results.

4.4 Mechanisms for Asserting Values

Participatory Design substantively builds into its methodology support for participation, workplace democracy, and (within the organization) fairness. To assert these values, PD, in its original form, rests on a legal framework, along with a relatively homogeneous culture and shared values. In cases when there is a power differential – as is typically the case with workers and management – PD has developed a set of techniques to help equalize power among the stakeholders during the design process.

Value Sensitive Design is potentially concerned with the full range of human values, but has a particular focus on values with ethical import. VSD ultimately rests on an appeal to the standing of the values at stake, particularly moral values. This appeal is bolstered by relevant empirical research in psychology on how people understand those values, both in general and in their specific culture, and how they act on that understanding.

For our explicitly supported values in UrbanSim, this has worked well so far. (It would probably be hard to find someone who would advocate that we write an unfair or biased simulation, strive for less accountability, or undermine the democratic process.) We are also aided by the milieu in which we are working: in public decision-making, with government agencies as the initial users. This is not to say that supporting these values is easy when it comes to developing the system – in fact it is extraordinarily difficult – but rather to say that the underlying commitment to these values has not been challenged.

For the stakeholder values, our intent is that UrbanSim will provide solid technical support for public deliberation and debate, so that different stakeholders can argue that one scenario or another better supports the things that are important to them – including projecting the long-term consequences, not just the short-term ones. So for the stakeholder values, we are ultimately relying on a legitimate and democratic political process, in which the use of the simulation is embedded. (Thus UrbanSim itself would not repair a fundamentally flawed context of use.)

In other applications of VSD, a simple appeal to the standing of the values at stake may well run hard against the realities of economic and political power. Our hope in such situations is that the results from VSD – including the different design alternatives that emerge, including ones that may better support human values – will provide material that can then be used in the political process, by political parties, government agencies, citizen's groups, and others. There is much for VSD to learn here from past success (and failures) of Participatory Design efforts.

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6. REFERENCES

The UrbanSim papers listed below, as well as the VSD technical report listed below, are available from www.urbansim.org/papers. For additional information on Value Sensitive Design, please see www.ischool.washington.edu/vsd.

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