Chapter 22
Recoding Embedded Assumptions: Adaptation of an Open Source Tool to Support Sustainability, Transparency and Participatory Governance

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Abstract This chapter traces the adoption of Envision Tomorrow, an open source planning support tool, in a large-scale planning effort within the Austin metropolitan region. A regional consortium of public, nonprofit, and private organizations was awarded a U.S. Department of Housing and Urban Development (HUD) Sustainable Communities grant to create and deploy an analytical tool for the assessment of district, community and regional-scale scenarios. Several dimensions of Envision Tomorrow are described in the chapter including its use: as a tool in participatory plan-making; as an analytical process that extends and structures how planners perform analysis; as a PSS that focuses on quantifiable sustainability indicators and thus supports the inscription of particular definitions of sustainability; and as a conduit of exchange between planners and university researchers and between planners and members of the public. The chapter concludes with a reflection on the virtues of transparency and adaptability. It also reveals embedded assumptions that represent both sources of promise and concern in the application of a PSS in planning processes.

1 Introduction

New web-based models for citizen participation (Brabham 2009; Evans-Cowley and Hollander 2010; Ganapati 2010; Koekoek et al. 2009; Seltzer and Mahmoudi 2013; Townsend 2013), advances in geographic information systems (GIS) modeling, and the growing application of scenario planning methods have spurred the production and use of new and improved planning support systems (PSS) (Bartholomew 2007). Scenario planning tools, in particular, seem to hold great promise for the creation, visualization, and analysis of alternative scenarios in

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which land use, transportation, the economy, environmental systems and social needs are considered holistically (Goodspeed 2013; Holway et al. 2012).

Scenario planning methods and tools are promoted by nonprofit, governmental and university-based groups. Nonprofit organizations such as the Lincoln Institute of Land Policy, Sonoran Institute and PlaceMatters bring together tool developers, educators and practitioners to advance scenario planning and associated tools (Holway et al. 2012; Open Planning Tools Group, undated; PlaceMatters, undated). Federal government initiatives, such as the Partnership for Sustainable Communities, have directed resources toward the use and development of scenario planning tools and integration of housing and urban development, transportation, and environmental planning through scenario planning (Partnership for Sustainable Communities 2014). While many scenario planning efforts were originally concentrated in the Western United States to address rapid growth, scenario planning tools and processes are increasingly used across the country. This is evidenced not only by the Austin metropolitan region's Sustainable Places Project, but Buffalo Niagara region's One Region Forward, which is aimed at responding to a trend of population loss and abandonment as well as suburban sprawl.

As more planners are drawn to the possibility of deploying PSS in scenario planning, it is necessary to reflect carefully on them. The coding, calculations and mapping functions embedded within PSS have important implications that may not be immediately apparent. What a PSS includes and what it leaves out, the limitations and extensibility of its structure, and the mechanics of its application should be carefully considered. This case study examines the adaptation and use of an open source PSS called Envision Tomorrow (ET) to aid a federally-funded regional planning process in the Austin, Texas, metropolitan region.

The following chapter traces four aspects of ET: (1) its use as a tool in participatory plan-making; (2) its use as an analytical process that extends and structures how planners perform analysis; (3) its use as a PSS that focuses on quantifiable indicators and thus supports the inscription of particular definitions of sustainability; and (4) its use as a conduit of exchange between planners and university researchers and between planners and members of the public. The chapter concludes with a reflection on the virtues of transparency and adaptability in a PSS and its significance for the creation of collaborative networks of planning researchers and practitioners. It also notes areas of critical concern. These include the embedded assumptions that must be carefully considered in the deployment of PSS. Additional concerns include observed limitations in the extent to which the results of PSS are actually shared with citizens in the process and the complications in doing so.

2 Calls for the Use and Production of PSS

As noted above, a convergence of nonprofit and governmental agencies are promoting the use of scenario planning tools and especially GIS-based PSS to deepen planners' analytical capabilities and public participation in planning (Holway et al.

2012; Open Planning Tools Group, undated; PlaceMatters, undated; Partnership for Sustainable Communities 2014; Chakraborty 2011). Consulting firms that regularly aid local and regional governments across the country also promote the application of their own scenario planning PSS (EnvisionTomorrow.org 2014, Calthorpe Associates, undated). Chakraborty notes that with *"a growing literature"* there is a need for *"more examples of innovative participatory methods and quantitative modeling techniques"* (Chakraborty 2011, p. 398).

Despite the promise of new PSS tools, the literature suggests barriers and limitations in their use. For example, Göçmen and Ventura (2010) observed that within a sample of public agencies, GIS is seldom used for modeling or spatial analysis and more often used for simple mapping or to access basic information. Bartholomew (2007) noted in an extensive assessment of 80 scenario planning processes in more than 50 metropolitan areas that: *"In many cases, citizens have not been meaningfully involved, the processes have been agenda driven, the differences between alternative scenarios and trend projections are slight, and effective implementation strategies have not been adopted"* (pp. 397–8).

Drummond and French (2008) have encouraged planners to take a direct role in the production of open source GIS tools that pair participation and analysis. They write that: *"academic planning programs willing to build the necessary expertise for this effort could develop new GIS analysis, design, and participation tools if local and regional planning agencies provided funding and a real world application environment"* (p. 173). Thus, the application of Envision Tomorrow in the Austin metropolitan region provided an important opportunity to respond to Drummond and French's call for the development of open source PSS. It also provided a ripe opportunity to observe the PSS's role in the process.

3 Methodology

Beauregard (2012) writes that in attempts to represent the workings of planning process and society, planning theorists often neglect the 'things' that shape planning processes. In an article that generally applies a Science and Technology Studies (STS) approach and more specifically Actor-Network Theory, Beauregard deconstructs an analysis of a planning meeting (initially recounted by John Forester). At that meeting, a site plan, a three-dimensional model, and photographs are used to augment deliberation over a proposed development. Beauregard elaborates:

"Without these things in the meeting room, the discussion that took place would not have occurred. Another discussion, with a likely different outcome, would have taken its place. And a different relationship would have been established between the planners and the developer's team. Among other consequences, things focus deliberations" (Beauregard 2012, p. 184).

This chapter is a partial response to Beauregard's challenge. The challenge to account for the agency of 'things', and especially technology, is issued from Actor-Network Theory (ANT). ANT is a body of thought, perhaps best described as a methodological approach rather than a theory (Latour 2005; MacMillan 2009) developed by Bruno Latour, John Law and Michael Callon, among others who have taken up the banner of ANT. In *Reassembling the Social*, Latour advises the social scientist to pay close attention to the role of technology in the making of associations, as it is a network of these flexible associations that constitutes society (Latour 2005). ANT is a methodology for tracing these networks of association.

Taking inspiration from Latour, this chapter seeks to share some of the everyday workings of a regional scenario planning project and to detail the ways in which Envision Tomorrow was used to construct alternative futures that encapsulate sustainability within a PSS in order to challenge development 'as usual' and identify and promote alternative sustainability scenarios for the future development of communities in the region.

This research is derived of participant observation in public workshops and charrettes as well as private research team meetings. This chapter also incorporates the assessments of colleagues who participated in and have written about the Sustainable Places Project. It foregrounds observations about the structure and function of Envision Tomorrow and the active and shifting construction of sustainability through the association of various human actors (planners and consultants, representatives of organizations in the consortium, and public participants in charrettes) as well as non-human actors. Non-human actors include the PSS itself, and the buildings, trees, stormwater management systems, and other aspects of the built environment and 'green infrastructure' that are embedded within Envision Tomorrow's calculations.

4 The Sustainable Places Project and Origins of Envision Tomorrow

The story of Envision Tomorrow's use in Central Texas begins with the award of a federal grant, although the development of ET began prior to the Sustainable Places Project. The Capital Area Planning Council of Governments (CAPCOG) and a consortium of other planning agencies, universities and nonprofit organisations applied for and received a U.S. Department of Housing and Urban Development (HUD) Sustainable Communities Regional Implementation grant. The consortium was awarded a 3.7 million dollar grant in 2010 (Capital Area Council of Governments 2012). A competitive selection process invited local governments within the region to participate (U.S. Department of Housing and Urban Development 2010). Participating local governments would serve as pilot areas where organizational partners and a cadre of planning consultants would apply ET in the creation of plans for demonstration sites. The sites were selected for their

potential to demonstrate the sustainability of mixed-use and transit-oriented development.

The initial proposal included IBM as a partner to develop a scenario planning analytics tool for the regional process. After a year of discussions with IBM, the university-based research team chose to seek out a PSS that had been deploying an already developed GIS, rather than investing in the creation of a PSS from scratch, as had been their initial intention. The university research team evaluated a number of PSS and decided to expand the capabilities of Envision Tomorrow, an open source tool that had been developed by Fregonese Associates, a well-known consulting firm based in Portland, Oregon.

Fregonese Associate's decision to make their system of linked spreadsheets and ArcGIS open source was a major factor in the decision to use it in Central Texas. While ET is described as open source, it runs as an extension of ArcMap, a desktop application within the proprietary software package ArcGIS and Excel spreadsheets. Although built atop two proprietary systems, the underlying calculations and development types within ET are open, portable and modifiable. The research team perceived ET to be flexible enough to be useful in multiple local jurisdictions, given the near ubiquity of Excel spreadsheet usage among local government planners and the ease at which they could see and modify embedded calculations in the spreadsheets. Another factor in its selection was the market domination of ArcGIS as a GIS platform for local and regional government planning departments.

The research team surmised that the scenario planning tool could be improved and adapted for the Sustainable Places Project and that the process of calibrating ET for use in Central Texas communities could be replicated in the many communities across the country that already use ArcGIS. ET seemed open and much less proprietary than prospects of a new analytical tool developed by IBM, where there had been no reassurance that planners would know how to operate the tool and no clear plan for its relationship to the GIS datasets and software packages planning departments were already using across the region.

5 Deploying Envision Tomorrow: Demonstrations of Its Use as a Participation Tool

Envision Tomorrow was used in five demonstration areas that had been designated 'activity centers' in a regional planning process called Envision Central Texas and in the region's Long-Range Transportation Plan for 2035. The demonstration areas were located in four small suburban communities: Dripping Springs, Elgin, Hutto and Lockhart. The fifth site was in Austin. Called the South Shores Site, it is located immediately across the Colorado River from Austin's downtown. The City of Austin's initial proposal was to focus not only on the South Shores site, but also another potential station stop for urban rail in the Mueller neighborhood, a new

urbanist community that had been developed on the former site of an airport (City of Austin 2011).

In the suburban communities, there was a three-part public participation process comprised of a visioning workshop, a planning charrette, and an open house. The visioning workshops were organized by several planning consultant firms with expertise in scenario planning and public engagement as well as CAPCOG and the University of Texas at Austin's research team. In each community, a stakeholder committee was formed that was involved in the organization of an initial community visioning workshop. At the workshop, members of the public and the stakeholder committee selected the most important indicators for assessing scenarios, discussed goals and values, and were invited to write specific development ideas on large base maps.

A second set of charrettes was organized in each of the four communities. At the charrettes, planning consultants provided a brief overview of the project and then participants were invited to break out into smaller groups of 5–10 people. At each table participants met around large aerial maps of the community and a facilitator encouraged participants to look over a menu of 'development types' that represented mixes of buildings and land uses. The menus gave figures for the number of jobs or housing units per acre and images that represented what the development types would look like if built. The facilitator encouraged participants to place 'development chips' on the map in order to create a vision of the community in the future. Each group would then give the map a title to represent their joint vision. Representatives from each table were asked to present their scenario to all attendees toward the end of the charrette.

At each table, a trained digitizer, in most cases a graduate student from the University of Texas at Austin, 'painted' the development types on a laptop with ArcGIS and the ET extension for ArcMap installed. Each digitizer captured citizen-generated scenarios in ArcGIS in real time. The idea was to enable the facilitator and digitizer to share indicators so that the scenario was done in an iterative fashion. Metrics would enable the participants to understand how many jobs and housing units their proposed scenarios would generate.

In reality, there was little time during the workshops for the facilitator and participants to discuss any of the indicators. The time allotted for the entire workshop was two and a half hours. With a presentation at the beginning and time allotted to share scenarios at the end of the evening, there was just enough time to get participants to settle on a joint scenario and to add development chips and other annotations to the base map. Digitizers were occasionally asked to report back to participants as to how the scenarios were performing. The digitizers primarily shared information about basic indicators such as total number of housing units and jobs accommodated or land use mix. It was rare for digitizers to have the time to share other sustainability indicators, such as estimated vehicle miles traveled, building energy or water usage, let alone to have the time to explain to participants what the indicators meant.

Additional factors that may have produced variation in the way the tool was applied at each table were facilitation styles among planners and the skills of

digitizers. Direct observation seemed to indicate that the tool was used fairly consistently across the tables, which was likely to be due to digitizer training prior to the meetings and facilitator protocols. The relatively limited amount of time allotted for developing scenarios seemed to keep both facilitators and public participants focused on placing development chips and discussing scenarios, rather than engaging in conversations around sustainability indicators.

At the planning charrette in one community, John Fregonese of Fregonese Associates, compared publicly generated scenarios with a 'business as usual' or 'trend' scenario. This presentation of the indicators was very quick with little time to explain their meaning. At the charrettes in other communities, even less time was allocated to sharing back the results of sustainability indicators. Instead, only a few of the sustainability indicators were discussed at the end of the night. Planners explained that the scenarios provided by participants would be analyzed after the charrettes and that these citizen-generated scenarios would be condensed down into a smaller number of alternative scenarios.

A third meeting in each community consisted of an open house in which members of each community were invited to view a 'base case scenario' or trend scenario alongside two scenarios. The open houses allowed members of the public to come and go in a relatively unstructured way during the time allotted. Members of the public circulated among poster boards illustrating three scenarios and a limited set of about five indicators showing the performance of each scenario. Participants chatted with representatives from the University of Texas at Austin and members of the planning consulting teams, local planners and public officials, among others. Participants were invited to fill out a survey to indicate their preferred scenario.

The planning process within Austin was significantly different than in the smaller communities. Instead of holding three consecutive meetings, planners from the City of Austin worked with Fregonese Associates to analyze existing conditions and to propose scenarios before inviting the public to participate. ET was used to generate redevelopment options that could be built under current market conditions and in accordance with ideas generated from a prior process sponsored by the American Institute of Architects. Students in the University of Texas at Austin's Urban Futures Lab, led by professor Dean Almy, utilized ET to generate an additional scenario for public consideration. A workshop was held in the South Shores District introducing attendees to scenario planning and ET. Instead of a planning charrette, the meeting was aimed at presenting the two scenarios already generated and comparing them to a 'business as usual' scenario.

The role of ET in the South Shores process was to aid local planners and university-based researchers and students in understanding market conditions and the feasibility and outcomes of expert-driven scenarios. The tool was not used to incorporate public participation into the generation of scenarios as it was in the other communities; instead, it was used in preparation for an informational session with the public. Photo simulation and 3D modeling were used in addition to ET to convince the public and city council members that the district should undergo a more extensive planning process. Public participation and finer-grained analyses

were promised if next steps were funded by the Austin City Council. The output from ET helped to describe the quantifiable benefits of scenarios. For example, a green infrastructure application developed for ET during the South Shores Project was used to illustrate how stormwater could be prevented from flowing into the adjacent Colorado River under one of the scenarios.

The South Shores planning process demonstrated how ET could be used for persuasive purposes, as a tool for shaping public opinion with or without participatory processes. I perceived no misuse of the tool; faculty and students at the University of Texas at Austin as well as planners at the City of Austin seemed to sincerely have the best intentions of the public in mind as they explored alternatives with the tool. However, it is worth noting that nothing in ET requires public input or participation.

Comments and questions from members of the public at the South Shores meeting seemed to reflect a general acceptance and support for new, mixed use and higher density building typologies. This was not particularly surprising; the City of Austin had been successful in garnering public and city council support for higher density, mixed use development in recent years, as evidenced in the recent adoption of a comprehensive plan (City of Austin 2012) that embraced concepts of smart growth.

More surprising was what appeared to be widespread support for compact, higher density, mixed use development types in the four smaller, suburban communities. Citizen-generated scenarios in these small towns differed significantly from existing development trends that favored single family tract housing and auto-centric big box and commercial strip development. Community participants placed development types in scenarios that included an ample number of multi-family units, compact neighborhoods with a mix of garden apartments and townhomes, as well as mixed use main street and town center typologies. At UT-Austin research team meetings, faculty and students registered both relief and some surprise that there seemed to be broad public support for a wider range of transit-oriented and mixed use development types and that the charrettes had yielded mostly positive results according to sustainability indicators. On the other hand, the research team noted resistance in one community where a group of Agenda 21 protesters distributed leaflets and spoke with great hostility at what they perceived as a United Nations and U.S. federal government conspiracy to force local communities to depopulate rural communities (for more information about Agenda 21 protests, see Wittenmore 2013).

6 How the PSS Structures Planning Analysis and Defines Sustainability

As noted above, the public participation process can be organized in multiple ways and the process for engaging the public is not defined by Envision Tomorrow. In contrast, ET does provide planners with a critical path to performing planning

analysis. The structure of the PSS facilitates a specific set of steps that move from modeling individual buildings to aggregating modeled buildings to development types, to sketching these development types as scenarios in ArcMap.

The first step in the process is for planners to define building types that serve as the building blocks of new development. In this first step, planners work with a Return on Investment (ROI) model to model the *"physical and financial feasibility of a proposed development or existing development regulations"* (Envisiontomorrow.org, undated). A planner can download and easily modify a set of building prototypes that range in type, such as mixed use buildings, light or heavy industrial developments, suburban or urban office buildings, and arterial commercial or big box buildings, among other types. The planner can then begin to address questions such as: *"What building types are feasible in the current market? What would X (e.g. rent, land cost, financing) need to be in order to achieve a desired building type? If certain regulatory constraints (e.g. height restrictions, high parking requirements or setbacks) were relaxed or removed, what new building types become possible?"* (envisiontomorrow.org, undated).

In ET training sessions for planners and students, representatives of Fregonese Associates demonstrated how the 'goal seek' function in the ROI spreadsheet can assist planners in finding public subsidy levels or making modifications to a building prototype's physical inputs that will result in a financially feasible development. One of the recommended methodologies for gaining information to be used in the model is through interviews and focus groups with developers and to compare this input to databases such as RSMeans. Thus the financial feasibility of new development is embedded in the first steps of the analytical process and the planner's drive to achieve a sufficient return on investment compels the planner to consider public-private partnerships or strip away requirements that hinder project feasibility.

In the next step, planners aggregate individual building prototypes into development types using ET's Scenario Builder. Development types are defined by percentages of building prototypes. Within development types, planners calibrate the mix of buildings to current development trends and to aspirational goals for development. As scenarios are painted, a set of indicators is available based on area calculations from ArcMap that are linked to the Scenario Builder spreadsheet.

Table 1 shows the indicators that are readily available in the Scenario Builder. While there are extensions of ET with additional functionalities, the following are core indicators readily available for use in evaluating scenarios. Sustainability is coded into the Scenario Builder in two ways. First, sustainability is defined through a set of indicators related to compact, mixed use, transit-oriented development. A narrower set of indicators are specifically defined in Scenario Builder as sustainability indicators and include measures of energy and water consumption and waste in the form of greenhouse gas emissions, waste water and solid waste generation.

An advantage of ET's spreadsheet structure is the transparency of its indicators and the formulae that underlie them. An additional feature is the embedded 'sketch tool' that, as discussed in the context of public workshops, hypothetically allows planners to track citizen-generated scenarios in real time.

Table 1 Indicators embedded in Envision Tomorrow Scenario Builder

Indicator type	Associated indicators	
Basic calculations	Developed acres Population	Net new growth
Compact, mixed use development	Infill development Building square footage mix	Land area mix Density
Housing	Displacement from redevelopment Housing mix Affordability Housing distribution by income	Housing by building type Jobs/housing balance[a] Affordability (Housing + Transportation + Energy costs)
Employment/jobs	Employment mix Jobs/housing balance[a]	Income
Transportation and travel behavior	Walk and transit friendliness Parking Bike trips Walk trips Transit trips Vehicle trips Internal trips	External trips Vehicle miles traveled (VMT) Traffic accidents ULI shared parking savings Transportation affordability Daily emissions
Fiscal impact and infrastructure	Financial Subsidy New infrastructure Tax revenue Tax revenue per new housing unit	Operations and maintenance costs Capital outlays Cost to revenue ratio
Defined as "sustainability" in scenario builder	Energy use (million BTU/yr) Carbon emissions (tons/yr) Landscaping water use (g/day)	Internal water consumption (g/day) Waste water (g/day) Solid waste (lbs/day)

[a]Appears in two indicator type categories

Beyond the core ability of planners to facilitate conversations and make maps, planners must continually decide what constitutes the content and boundaries of applicable planning knowledge. They are continually pressed to assemble best practices and planning knowledge that can be applied to local contexts and combined with citizen input and local knowledge. The flexible spreadsheet of assumptions is a means of collecting planning knowledge about development performance. It serves as a method for calibrating planning research to local conditions. Coded into ET's ROI and Scenario Builder tools are not only formulae, but their sources with references to academic research and common heuristics used by planners and developers from around the country. Certainly in the context of a

large-scale federally funded demonstration project that brought together local and regional agencies, multiple planning consultants and university partnerships, the nature of planning knowledge needed to be clearly documented and communicated. The components of ET served that function.

A criticism raised by researchers involved in the project was the omission of equity among ET's core indicators (Oden et al. 2014; Jackson 2013). An attempt to code in equity, as well as other definitions and indicators of sustainability, is described in the following section.

7 Recoding and Extending Envision Tomorrow

Critiques of the limitations of embedded calculations in ET fueled the expansion of sustainability metrics to address equity and green infrastructure, among other indicators. To address the lack of equity indictors, a faculty and student team developed several new applications (Mueller and Torrado 2013). One such application involved the use of ET's Redevelopment Candidate application, which had been created to enable planners to identify parcels that are likely to redevelop. Inverting the purpose of this application, Mueller and Torrado created a process to use the Redevelopment Candidate application to identify parcels where there is redevelopment pressure that threatens to displace low income renters. This modification essentially inserts equity concerns in the equation, without which a planner might otherwise assume that redevelopment is simply a desirable outcome and ignore the impacts to vulnerable populations or the supply of affordable housing in the study area.

In the process of coding in equity, the research team found that ET's indicators were structured into the PSS at the scale of building and district. Equity is by definition a measure of comparison, often at the district, neighborhood, or regional scale and most often beyond the scale of individual buildings (Oden et al. 2014). Therefore the structure of ET made full representation of equity as a sustainability indicator difficult.

Another faculty and student team extended ET to monetize and represent ecosystem services associated with street trees in development scenarios (Hilde and Paterson 2014). This extension of ET built on the U.S. Forest Service's iTree suite. Central to this accomplishment is the union of two disparate practices to extend the definition of sustainability and reinforce the value of urban canopies in land-use planning. The team explained:

"Traditionally ecosystem services and land use planning have existed as separate disciplines and opportunities to consider both in tandem would be unlikely or not feasible due to 'black box' software platforms. Herein lies the benefit of ET's open-source format: utilizing the familiar and accessible MS Excel platform allows underlying tabular data (which drives the scenario measurement and analysis) to be modified and supplemented. Thus while in the past proprietary software tools would be difficult to integrate, and disciplines such as planning and urban forestry

would not interact, the current environment of free tools with transparent coding is allowing cross-disciplinary integration to become more feasible (Hilde and Paterson 2014, p. 528)".

The application associates particular development types (assemblages of buildings) with trees. This association can be customized by planners; therefore, it is adaptable and the association between development types and trees is not rigidly specified. Where the potential for rigidity is expressed is in the reduction of the value of trees from object to ecosystem services (which may be qualitative or quantitative, such as aesthetic value or the reduction of urban heat island effect) to an output in terms of economic value. Thus, the embedded assumptions and their ramifications are multiple: (1) the application expands the constellation of non-human actors that are considered in the search for a sustainable future scenario; (2) it reinforces the notion that economic valuation is the best currency for planning analysis; and (3) it holds that valuation of ecosystem services as static and unproblematic. This last point is important, because the notion of static 'valuation' has been challenged by anthropologists who have emphasized that valuation is complex and is continually *"being combined, tinkered with and reinvented"* (Caliskan and Callon 2009, p. 387). This is just the kind continual assembly of associations between human and non-human actors that ANT is preoccupied with revealing.

In Bruno Latour's nomenclature, the additional calculations can be seen as "inscriptions", or the translation of the empirical world through maps, diagrams, calculations, and reports (Latour 1987). Thus a concern for the value of trees was inscribed into the tool, which could then influence considerations in future planning processes. Close study of the iTree application in ET reveals a process of inscription and valuation that can assist the thoughtful planner who is intimately involved in applying the tool. To the planner who just wants to get the analysis done or to the 'consumer' of planning information, the valuation may appear an unproblematic statistic or fact. Upon closer examination, the conversion of ecosystem services into monetary value seems to feed the assumption that the most sustainable solution for urban tree canopy has the highest monetary value, to the potential cost of more nuanced discussion of how best to plan an urban forest and incorporate it into planning.

Planners at the City of Austin and another set of University of Texas faculty and students also participated in the creation of a Green Infrastructure application that extended the ability of planners to incorporate best practices in stormwater management. Figure 1 is a screenshot of this application. In the screenshot, the 'Green Infrastructure Medley' option has been selected which, according to tips on the screen, consists of 'a mix of green roof, rainwater harvesting, and rain gardens'. Although it is not shown in Fig. 1, the model calculates the removal of pollutant loads associated with different options, from 'No Green Infrastructure' to 'Minimum Green Infrastructure' to the 'Green Infrastructure Medley' depicted below.

Interestingly, the financial statistics remain a prominent part of the application. Figure 1 shows the Internal Rate of Return (IRR) on Project Cash as −4.4 % as compared to a Target Return of 12.0 % for an example building prototype. The IRR is the average annual rate of return from a development over a time period for

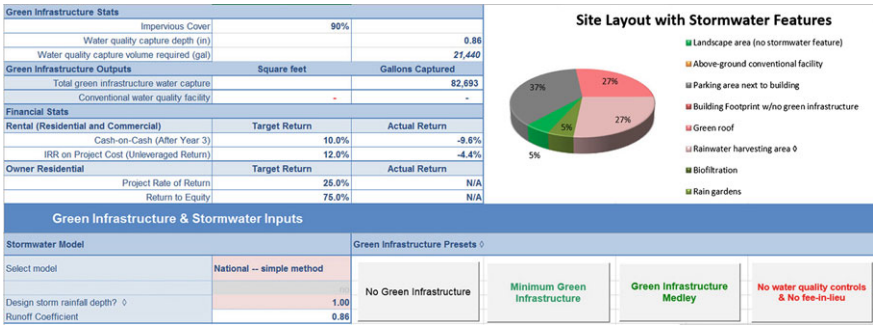

Fig. 1 Screenshot of the Green Infrastructure app embedded in Envision Tomorrow's ROI tool (reproduced from building prototype downloaded from Envision Tomorrow website)

which an investor is involved in a development (Nelson et al. 2012). Therefore, the planner is encouraged to split his/her attention between the potential benefits of green infrastructure and the site level financial feasibility of a development project. As described above, the benefits and costs of an individual building are included within 'development types' that calculate the aggregate values associated with a mix of building prototypes. By including green infrastructure in the ROI tool, planners are encouraged to think about the value of green infrastructure strategies. In a sense the value of trees, plants and soil are encapsulated as agents of positive urban change; in the concepts of ANT, they become assembled as actors within a network that defines sustainable scenarios.

Thus planners are encouraged by what is included in the tool to pursue site-level strategies to reduce pollution. Other benefits of green infrastructure, such as potential monetary value or increase in quality of life indicators are not represented in the quantitative model, although planners were observed in planning processes using attractive renderings and other depictions that spoke to the potential aesthetic and place-making values of vegetation and soil.

In addition to the embedded assumptions of the spreadsheets, the research team noted the inability to analytically explore relationships between development types in ArcMap, pointing out that the GIS sketch tool was primarily used for area calculations. Most of the analytical power of ET is accomplished not in the GIS, but in the Excel spreadsheets. Missing from the GIS extension were the kinds of fragmentation and interaction analyses more common to environmental analyses. This was an area where researchers had limited ability to quickly build in new routines. Modifications to the ArcMap extension required more extensive coordination with ESRI, illustrating the place where the easily adaptable, open source nature of ET stops and the complications of modifying proprietary software begin.

8 Observations on the Limits of Participation

Both during and after the Sustainable Places Project, members of the research team produced documentation in the form of working papers, articles and a thesis. Conclusions ranged from critique of the process and outcomes of the planning process (Oden et al. 2014; Jackson 2013) to optimistic demonstrations of the adaptability of the software to address additional sustainability indicators, as described above (Hilde and Paterson 2014). In addition, a doctoral student from MIT studied the project, comparing the Sustainable Places Project with scenario planning efforts in Boston and Kansas City (Goodspeed 2013).

Oden et al. (2014) identified four problems with scenario planning within the Sustainable Places Project: *"(1) roles and representation of various publics in the planning process; (2) analytic pitfalls; (3) political tensions surrounding development and redevelopment; and, (4) integration of equity concerns"* (Oden et al. 2014, p. 8). The authors emphasized a lack of representation of lower income residents, a segment of the population that, according to HUD criteria, should be a major participant and beneficiary of the planning process. In addition, they noted how the emphasis on individual demonstration sites essentially devolved a regional effort to the scale of four small communities and an urban district. They were disappointed that the process did not result in forging a common regional approach to equity.

In an addition, Jackson interviewed stakeholders from the four small suburban towns (Jackson 2013). Although there was a low response rate and results were mixed, Jackson found sufficient evidence that casts some doubt as to the efficacy of Envision Tomorrow in shaping the development of scenarios in the charrettes:

"Subjects had a general understanding of the indicators used in Envision Tomorrow and what they implied, but they did not appear to use them to guide their scenario development. As a participant at design tables, it appeared that residents found them occasionally useful but for the most part designed scenarios based on the opinions of individuals on certain parcels or areas of town" (Jackson 2013, p. 152).

He noted that *"interviews suggest that the indicator results did serve effectively as a sort of 'check' on plans after the fact, but this is not the same as an iterative process in which residents gain a more organic understanding of the analysis"* (Jackson 2013, p. 158). He observed that a lack of iterative use of the indicators, in which participants understand and discuss trade-offs may indicate *"little true social learning"* (Jackson 2013, p. 159). In fact, he attributed the positive performance of preferred scenarios generated by the public as potentially tied to a social network of workshop participants who were involved in landscape, architecture, urban planning, and urban design. Additionally, economic indicators appeared more of a concern for residents and city officials than the environmental or social indicators.

Jackson also described the development and utility of the aforementioned extensions of ET. These extensions were developed in the planning process, but not fully integrated in the analysis for every community. In fact, many of these indicators were never unveiled or integrated into the public participation process,

having been developed too late or deemed too complex for the series of public workshops and charrettes.

Goodspeed (2013) used observational and survey methods to assess the extent to which the Sustainable Places Project achieved social learning in the four suburban communities. He noted that the analytical contributions of ET's indicators were limited to only four indicators of which *"three were summative and one an analysis of the impact of development on tax revenues"* (Goodspeed 2013, p. 173).

These critiques correspond closely with my own observations. Some public participants appeared interested and impressed by the technology used to create scenarios, but actual engagement with ET and its indicators was limited. Much of the material shared with the public, in print or web materials and at community meetings was boiled down to include only a few indicators. The superficiality of the public's engagement with the indicators contrasted with the level of engagement by planners, researchers and students. These participants strove to learn, implement, incorporate and extend the analytical capabilities of ET. The state of planning research related to sustainability and how this could be represented in ET were discussed extensively by the research team and planners. Thus, the tool provided an important conduit of knowledge exchange between practitioners and academics, while the exchange between planners and the public seemed more limited and constrained.

9 Conclusions and Recommendations

Observations on the use of Envision Tomorrow to successfully support sustainability, transparency and participatory governance in the Austin metropolitan region are mixed. There was evidence that ET structured planners' processes and concerns and enhanced their analytical capabilities. Modifications to ET show how the tool can be open and transparent—planners can access the formulae and assumptions behind the sustainability indicator outputs and, in conjunction with software developers or through manual processes, they can change them and add more. On the other hand, the existence of those formulae and the ability to recode them did not ensure that citizens had access to either the indicators or the means of deriving them or that there was an opportunity to discuss them. Nor did it ensure that the indicators were actually used in determining final preferred scenarios.

In examining the use and development of a PSS, there is a danger of assuming a kind of instrumental rationality or a technological determinism in its use. Planners and researchers can too easily and implicitly assume that a PSS is applied in a disinterested, objective fashion in the production of facts and for use in coming to a rational decision about an optimal future scenario. It is evident from observations of the Sustainable Places Project that it is fairly easy to transform a scenario generated either by the public or by planners into a 'black box' of facts that are selectively presented without caveats or context. If open houses, charrettes, and workshops do not reveal the calculations and assumptions behind scenarios or within the PSS, there can be an illusion of rationality and scientificity that transforms heuristics or

calculative assumptions based on provisional knowledge into known facts (Jackson 2013) or persuasive materials leading to public consent. Yet, opening embedded calculations to a potentially deeply divided public opens up planners and their knowledge to questions and concerns they may feel ill-equipped to answer.

Perhaps most hopeful are observations that a flexible and transparent PSS can help planning practitioners and researchers collect and transmit best practices, heuristics and the state of planning knowledge. The most substantial learning outcomes seemed to have been among the researchers, practitioners and students who could experience firsthand the complications of both analysis and participation. They were charged with disassembling the technology to understand how it works and reassembling it with new ideas and methods. When properly resourced and coordinated, this case study illustrates how a constellation of smart growth and sustainability concepts can be linked to assist in the generation of new visions of the future and in inscribing concern for more aspects of the built and natural environment. In the collection of these assumptions within a PSS there is hope that planners can continually question them. The PSS and the scenarios generated within them need not be black boxes; if assumptions are available and modifiable, then the technology allows for assembly of new concerns, people, 'things', and concepts into different and potentially more representative models of future scenarios. This case study highlights the importance of inviting professionals and citizens alike to recognize and deconstruct embedded assumptions in the planning process and to recode them anew.

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