Developing the Next Generation of Scenario Planning Software

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This presentation reports on the design and experience of a UT team of faculty that have been developing the next generation of scenario planning software under a HUD Sustainable Communities Implementation grant. The project aim is to create software that corrects many shortcomings of current professional scenario planning software. The project is creating an open source, freeware suite of scenario planning software tools that have several important and innovative elements: (1) a standardized data schema for planning information systems to streamline scenario planning applications; (2) a GIS data wizard system on an Arc-GIS platform that repairs common data errors in creating data layers needed for scenario planning to reduce user transaction costs; (3) a more user friendly, interactive scenario software package with a broader array of sustainability metrics and analytics built on the Envision Tomorrow software package as the backbone; (4) a social learning and design solutions interface that teaches planners and laypersons about various sustainability indicators as well as possible planning and design solutions when indices begin to go in an undesirable direction; (5) an online public involvement feedback system so scenario planning workshops can be explored by the broader public through on-line engagement interfaces; and (6) the integration of 3D simulation modeling with the scenario software (as well as compatibility with ESRI’s CityEngine software for future 3D modeling). The goals of the project are to make scenario planning for sustainability in Texas, and the US, more (1) accessible, (2) more user friendly, (3) more powerful in terms of the range of analytics, and (4) more adaptable for an open source GIS platform.

The Sustainable Communities Partnership and Scenario Planning

In June 2009, the Secretary of the US Department of Housing Urban Development (US HUD), Shaun Donovan, announced the Sustainable Communities Planning initiative coordinated within the Federal
government’s Interagency Partnership for Sustainable Communities. The Obama Administration goal was to transform the way federal grants and programs facilitate sustainable development practices in US metropolitan regions by creating better interagency coordination and cooperation, and providing planning and implementation grants to regions that propose to collaborate and define a shared vision of sustainability through regional planning. That initiative led to the creation of the new Office of Sustainable Housing and Communities within HUD to coordinate the initial $100 million grant program. Three federal agencies— the US Department of Transportation (USDOT), the US Environmental Protection Agency (US EPA) and US HUD—committed to focus their major grant and infrastructure investments to help advance six overarching Livability Principles. The Livability Principles aim to help American families gain better access to affordable housing, have access to more transportation options with lower transportation costs, all while protecting the environment and reducing energy dependence on fossil fuels.

In 2011, US HUD expanded the initial planning grant program to include a second category of grant recipients—Detailed Execution Plans and Programs for those regions that already had completed and adopted a regional sustainability plan. An additional $67 million in grant funds became available for the second year of the program. Seventy-four regions were recipients of the Sustainable Community grants (see figure 1 below), however the Interagency Partnership for Sustainable Communities itself boasts $3.5 billion in directed support to metropolitan regions in the US.

A consortium of Central Texas governments, NGOs and interest groups received one of the 2011 Sustainable Communities Partnership implementation grants. The Consortium proposed to build off the region’s prior regional planning ventures to develop a next generation scenario based planning software suite to help the region’s 20+ cities and five counties implement the preferred regional vision adopted through the Envision Central Texas process. This essay describes the Central Texas regional collaboration and the network of partners that formed to develop the software suite that will be completed by the end of 2013. It next describes the problems that the research team identified from the literature and from their own Central Texas scenario planning experience that the software design will address. The third section of the essay describes the software components developed or under development to date. The essay concludes with a discussion of the long-term objectives for the software on an open source platform with internet browser accessibility.


Over the last two decades, several Central Texas communities have used scenario planning to explore alternative land development options as well as to chart a vision for the region’s future. The University of Texas at Austin faculty have been involved in many of those processes as both project leaders and as participants. One of the more influential examples was the 1995 Community Vision Project led by UT faculty members.
Kent Butler, Bob Paterson and Susan Handy. Sponsored by the regional transit authority—CapMetro—the UT team conducted two regional charrettes with follow up focus groups to explore alternative land use and transportation development models for Central Texas. At the largest event, over 300 people participated in the scenario planning process in the Austin City Coliseum exploring alternative development scenarios for several different land use context (e.g., greenfield edge, suburban corridor and urban infill development). The guiding principles provided guidance to the City of Austin’s crafting of a Neo-traditional Development ordinance.3

A second effort, the Montopolis Land Use Study, led by Professors Bob Paterson and Kent Butler4 (1996) explored four alternative development scenarios through a participatory planning process for a low income neighborhood that was being impacted by the relocation of the regional commercial airport to its southeastern border. Alternative development scenarios for the community were discursively explored with interdisciplinary teams of architects, planners and landscape architects working with community residents within the community recreation center. The project provided alternative land use scenarios, goals, values and data for the subsequently adopted Montopolis Neighborhood Plan.

Another important Central Texas scenario planning experience was the Triangle Park project which involved two separate charrette processes under two different design firms—Genesis Group (Tampa, Florida) and Fregonese Calthorpe Associates (California). The goal in both efforts was to seek a compromise land use scenario that met city, neighborhood and developers interests (Clark-Madison, 1998). It was the creative alternatives explored with Peter Calthorpe that eventually broke the impasse between the city, neighbors and developers. Several member of the UT faculty research team attended these events and participated as citizens at the tables.

The fourth, and undoubtedly most important scenario planning effort in Central Texas prior to 2012, was the regional visioning and scenario planning that was undertaken by the non-profit group Envision Central Texas (ECT). ECT was formed in 2001 by coalition of community, business and government leaders from Bastrop, Caldwell, Hays, Travis and Williamson counties to discuss the development of a common vision for the Central Texas’s growth for the next 40 years. ECT employed Fregonese Calthorpe Associates (FCA) to manage the scenario planning process, including the development of sustainability feedback indicators. Over the next four years the group worked to develop The Vision for Central Texas, a regional growth plan for 1.25 million additional residents and 800,000 new jobs over 20 to 40 years in the five-county region. The formal ECT planning process began with an inventory of the region. Focus groups and a telephone survey were conducted to find out what Central Texans most wanted to preserve or change in the face of rapid growth. Findings from this outreach phase confirmed the need to plan for the region’s future, as well as the need for community involvement throughout the process.

Using the Envision Tomorrow scenario-based planning software tool developed by FCA, a baseline or trend scenario was first modeled premised on the assumption that current trends would likely prevail if no further actions or initiatives were taken to alter Central Texas’ future. Since “sprawl” was the predominant development pattern occurring in Austin at that time, this became the baseline scenario’s pejorative title (by many). That baseline scenario served as the basis for comparing alternative future growth scenarios through participatory planning processes. To create these scenarios, a series of geographically dispersed region-wide public workshops were conducted to collect opinions and data from residents on how to shape future development. Hundreds of residents of different parts of Central Texas worked with facilitators and planners to explore different options for land use, transportation and open space preservation. The four scenarios explored were:

Scenario A - Trend (sprawl model),

Scenario B - Corridors (with growth concentrated within one mile of major transportation corridors with greater amounts of mixed-use, infill and redevelopment than Scenario A),

Scenario C - New Towns (concentrated clustered development in new and existing towns throughout the region and slightly more redevelopment and mixed-use development than Scenario B). Scenario C also offered a greater diversity of housing and better jobs-housing balance in all parts of the region than the prior two scenarios.

Scenario D - Centers concentrated growth in the most mixed-use development patterns, while concentrating the greatest amount of development in existing towns and cities. That scenario offered the greatest range of housing and transportation options, preserved the most open space other three scenarios. An extensive public engagements process then
solicited feedback on the scenarios and a hybrid scenario taking the best liked elements from scenarios C and D led to the adoption by the ECT board of the Preferred Regional Scenario for Central Texas. This was an important moment for Central Texas as that preferred regional vision became the impetus for the creation of a regional greenprint to preserve the open space networks clearly at risk in the preferred vision as well as the basis for the MPO’s regional transportation plan.

While all four scenario-planning examples were ultimately considered success stories to varying degrees, all four suffered from significant limitations that have been identified elsewhere in the scenario planning literature. Firstly, all four examples involved extensive data collection and analysis stages in preparation for the scenario planning. While all forms of land use planning require considerable time and energy to assemble current information on land use, social, housing, economic, environmental and infrastructure and public services conditions, scenario planning adds some additional effort in terms of creating or assembling analytics to explore consequences of scenarios under consideration. Moreover, since more and more planning is completed using GIS databases, a significant amount of time can be lost just cleaning and making data layers compatible for planning purposes. The ECT process that used an earlier version of Envision Tomorrow software, took close to three years to complete (with the first year dedicated largely to analysis, mapping and visioning efforts). Ideally the next generation of scenario planning software should help to reduce GIS data preparation and cleaning transaction costs.

A second common critique of the Central Texas scenario planning efforts has been that the scenarios are not really based on any real world market limitations. In reality, two of the projects accomplished this to some degree: (1) the Triangle Project planning process did have the developer at the table running the numbers on the alternatives to verify that proposals were market feasible and offered sufficient profit margins; and (2) ECT’s consultants did regional market focus groups with developers to make sure the development types modeled were reasonable for the Austin market in the near future. Nonetheless, ideally, the next generation of scenario planning software needs help in curbing planning that is overly utopian or untethered to economic realities by incorporating market based analysis fully into the future land use and infrastructure proposals.

A third limitation of the scenario planning efforts was that the sustainability or feedback indicators, in many cases, were quite limited relative to the interests of the communities, and in most cases had to be reported back to participants in follow up meetings, since the analytics could not be computed in real time in the workshop setting. For example, if a workshop participant wanted to know how much more walking or biking in a denser, mixed use community might realize, the usual response in a community workshop would be to reference what had been experienced in another community like Portland or Sacramento. A reasonably exact context specific answer to that question in Central Texas would require modeling and analysis that currently is not part of the current generation of scenario planning software. Moreover, in many cases, core questions like “Can we afford that kind of land development...
At all four scenario planning workshops interesting questions arose about possible consequences of alternative scenarios. However, the current generation of scenario planning software does not enable users to quickly access greater information on important indicators or issues, or to learn more about possible solutions to problems. So, for example, in the ECT process, the issue of impervious cover came up often in a regional planning workshop because of the known adverse water quality impacts associated with runoff from impervious cover. Lacking from that experience was an ability to pull up examples of low impact development best practices that might ameliorate to some degree the impervious cover impacts of denser urban development. Thus, the next generation of scenario planning software should take advantage of electronic media linking, and the use of pop-up windows to better inform users about planning and design solutions for adverse consequences.

A major challenge to all forms of community planning, not just scenario planning, is the N-table problem. This is drawn from negotiation theory, where a common problematic after negotiators have crafted a deal is that they find that they have second, third, or fourth round of negotiations that must happen among their own constituency who have not learned about the deal as well as the lead negotiator(s). N-table refers to how many other subsidiary negotiations must follow from a multi-stakeholder negotiation process. The same situation exists in public participation in scenario planning, where the hundred or more residents that attend a charrette to undertake scenario planning often learn a great deal at the workshop, but their neighborhood constituents are left behind in that learning process. Thus, the next generation of scenario planning tools should enable on-line interactive sharing, perhaps even in real time. If not real time, then at least learning about completed scenario results from a workshop – such as is done with the proprietary MetroQuest services— as well as offering the possibility of browser supported scenario painting, are other means of wider public engagement.

A sixth limitation to the scenario planning conducted to date is that much of the work is 2D in character. Color coded land use maps do not convey many of the place making principles of the scenarios under discussion in a format that informs participants about what the future really might look like, or that is at least rudimentarily convincing in most cases. Many of the charrettes in Austin did have architects, urban designers and others to help make quick sketches of land use ideas. However, in most cases, these were too crude to really give an idea of how those alternative futures compare in 3D in the existing landscape and built environments. Thus, the next generation of scenario planning software ideally will allow for reasonably realistic 3D simulation of alternative futures, ideally in real time at workshops.

A seventh and final limitation is that connections from scenarios to implementation choices are often lacking. Many alternative scenarios will require new regulations, infrastructure investment and incentive systems to name a few implementation approaches. Ideally the next generation of scenario planning tools will seamlessly link to information on plan implementation techniques.

The following section describes how the Central Texas Sustainability Consortium and Partners have been working to address these limitations as part of their US HUD Sustainable Communities Regional Implementation grant.

2. Assembling the Team and Pieces of the Next Generation of Scenario Planning Tools

The Capital Area Texas Sustainability (CATS) Consortium is a broad-based collaboration of public, private, academic and nonprofit stakeholders in the Central Texas region (Austin-Round Rock MSA) that was assembled to build on the region’s previous sustainability efforts and to implement the region’s plan and vision for sustainable development. At the start of the project the core members and partners of the consortium included:

- Capital Area Council of Governments (Lead Fiscal Agent)
- Capital Area Metropolitan Planning Organization (CAMPO) (the regional transportation authority)
- Envision Central Texas (ECT) (a 501(3)(c) nonprofit organization for regional planning and implementation)
- City of Austin, including its planning, housing, transportation and economic development departments
- City of Round Rock (second largest city in MSA)
- City of San Marcos (growing university city south of Austin)
- University of Texas at Austin, The Center for Sustainable Development (lead center), The Texas Advanced Computing Center, and the Center for Transportation Research, and
As noted in the prior section, the foundation of the CATS Consortium sustainability implementation effort is the regional vision and preferred growth scenario developed between 2002-2004 by Envision Central Texas (ECT), that had extensive community participation by more than 12,000 Central Texans. The preferred scenario’s physical plan reflects efforts to concentrate substantially more growth in largely existing community centers and to move regional transportation infrastructure investments toward more multimodal choices including transit, biking and pedestrian systems. In 2008, ECT undertook a progress assessment on regional efforts to implement the adopted plan and vision, and concluded that while there remained strong support for the regional vision and the need for coordinated land use and infrastructure planning, a major barrier to implementation was that many localities lacked the resources to plan and implement plans in their own jurisdictions.

Many localities lacked the staffing and technical support to craft centers plans, CIP programming and land development code modifications to implement the preferred scenario in their own jurisdictions. Despite those limitations in terms of local efforts to advance the vision, two important accomplishments were completed in the years immediately following the ECT plan that added both credibility and stronger coordination of regional planning efforts: those were (1) the Central Texas Greenprint and (2) the CAMPO 2035 Long Range Transportation Plan. The ECT vision and preferred growth scenario and Greenprint in turn informed the creation of CAMPO’s 2035 Long-Range Transportation Plan, which envisions future regional growth being accommodated in a network of 37 mixed-use, mixed-income, walkable, transit connected and supportive Activity Centers that provide a balanced mix of jobs, housing and services, primarily within the context of existing communities (see figure 4). The Activity Centers concept is designed to improve the region’s livability outcomes in such areas as transportation system performance, air and water quality, and social equity and opportunities for revitalization. Under the Centers Concept, funding is targeted to expand the region’s public transit system (including buses and rail), to implement a network of high capacity roadway lanes, and to build new arterials serving the mixed use centers. CAMPO intends to create a specialized program that sets aside 50 percent of future Surface Transportation Program Metropolitan Mobility funding for projects that support the activity centers shown on the Centers Concept map. Those funds would be available to a wide range of projects to enhance transportation and livability in Activity Centers, including bicycle and pedestrian improvements, travel demand management projects, transit projects, and planning studies. Project selection is expected to be based on the extent to which the transportation project would leverage local planning and investment resources to create a successful mixed use activity center over time.

In its grant proposal to HUD, the CATS Consortium focused on the development of the next generation of scenario planning software in conjunction with regional partners to bring the

Figure 3. The Central Texas Greenpoint
Activity Centers concept to fruition. Local demonstration communities volunteered to partner with the software developers and planners to help development and provide feedback on software development. The core elements of the project include:

1. Development of a Sustainable Places Analytic Tool in partnership with the University of Texas partners and contractors that allows for scenario based planning at multiple levels with sustainability metrics that are responsive to local values and concerns within the host localities and their Activity centers. Creating a suite of software tools that better enable local scenario planning as well as furthering local implementation of the regional vision and activity centers plan.

2. Demonstration Projects (applying, testing and refining the analytic tool) at selected Activity Center sites to implement best practices for, and overcome obstacles to compact, mixed-use, mixed-income development with balanced jobs and housing linked to the local and regional multimodal transportation network.

3. Broad-based community engagement (along with focused engagement around Activity Center demonstration sites) to build awareness and consensus around the Livability Principles and sustainability strategies.

4. Development of, and ratification of a Regional Compact between cities and other jurisdictions committing to the adoption of common planning elements and supporting the coordination and integration of local comprehensive plans.

The Consortium and its partners assembled a team of planning academics and consulting firms to accomplish the Sustainable Places Analytic Tool that will be discussed in the next section.

A. The Sustainable Place Project Data Schema and Wizard

During focus groups with the Central Texas region’s local planning directors, the project team learned that one of the more significant barriers to the use of scenario planning software at the local level are the substantial transaction costs associated with getting ARC GIS data layers needed to do the analysis, ready for use and imported in a compatible format with the software. Although a great deal of land use, economic, social, demographic, environmental, and infrastructure data is readily available in ARC GIS compatible formats, a number of issues can arise and require data cleaning and other forms of manipulation (e.g., differing projection systems) to be compatible enough with the ARC GIS software to be accurate and usable for scenario planning purposes. The CATS Consortium contracted with Criterion Planners Inc., (also owners of the scenario planning software package known as INDEX), to create a standardized data schema and data quality wizard to (1) reduce time loss due to uncertainty about GIS data formats and fields, and (2) to provide automated routines to correct common data cleaning problems such as removing bad geometries (e.g., null, self-intersecting, irregular polygon slices, etc), street-centerlines-to-parcel-rights-of-way alignment checks, multi-part demographic parcels split issues, proper boundary-to-land-use split issues, proper boundary-to-land-use split issues, proper boundary-to-land-use split issues.雷切尔
the software can be ported to an open source platform as those GIS options become more viable in the coming years. The data schema and wizard is designed to reduce uncertainty and increase transparency and ease of use for the new software system.

The Portland Metro region has been working for over 20 years at creating a uniform planning information system with a standardized data schema to minimize planning costs and improve government efficiency. The geodatabase system created with Criterion will not supplant the intergovernmental coordination that is needed to get to Portland's level of standardization. However, it will provide metadata standardization and an easily portable geodatabase storage system for the preparation of scenario planning and templates that can be the foundation of data standardization efforts.

B. The Sustainable Places Project: Envision Tomorrow Plus Software

The CATS Consortium considered a variety of alternative software products to work with that were already considering going open source so they could meet the terms of the US HUD grant recipients. After meeting and discussing the project with multiple software vendors, the CATS team selected the Envision Tomorrow (ET) software package created by Fregonese and Associates because it came the closet to meeting many of the CATS consortium objectives. First, as a result of an existing collaboration with the University of Utah Metropolitan Institute, the ET software was already undergoing changes in terms of modeling land use scenarios from a building typology instead of a land use or place based typology. By basing land use planning scenarios on a building library, it becomes possible to create development pro formas for each building type to ensure that market feasibility is built into the model from the beginning. Typically a library of 30-40 buildings with a pro forma for each building type is created as background work to scenario development based on a series of focus groups with area developers. Once that step is completed, land use classes or place types can be constructed from a cross section of building types, reflecting variations in land use densities and intensities for urban, suburban and rural market conditions. This is called the Return on Investment Analysis System which is an interconnected group of excel spreadsheets that are linked to the ARC GIS attribute tables. Professor Chris Nelson at the University of Utah has upgraded the ROI model to make it more nuanced and sophisticated than the version that had been used for the ECT process ten years earlier.

A second major advantage of the ET software was the interplay between Excel building information and sustainability indicator formulas. Thus, once a design workshop begins and alternative land use and transportation alternatives are being painted in ARC GIS, the results are being dynamically relayed to the spreadsheets enabling on the fly calculations of sustainable community metrics that can be viewed in parallel format with the scenario development. This enables real time learning of the consequences of multiple land use choices through an interactive display. The University of Texas at Austin, the University of Utah and other partners have created a new suite of sustainability analytic tools and indicators that can be selected by localities to explore the consequences of alternative development schemes depending on the communities’ specific values and interests. Teams at the University of Texas and at the University of Utah are working to add new functionality and improvements in analytics in the areas of land-use transportation (e.g., a 7D model for exploring changes in mode choice, VMTs and other metrics on the fly as well as transportation accident and fatality variations). It is expected that somewhere on the order of 40-45 sustainability indicators will be usable by most users, although some models will require some additional local calibration to be meaningfully applied (e.g., a local fiscal impact model is being developed but will require some work to be calibrated to each locality). A housing and transportation costs estimator will allow analysis of the interplay between the two elements, and estimate the combined housing and transportation costs from different scenarios. An air quality and greenhouse gas estimator have been created based on changes in VMTs and mode shifting from alternative land development scenarios. Many other analytics are under development with the idea being that the software will ultimately function like an apple iPhone, where open source code allows for the additional growth of useful apps by the user community. This ideal has already been accomplished in an application of the software system to analysis of existing land use scenarios for a tract of land on Lady Bird Lake. The City of Austin adapted green infrastructure metrics from the Center for Neighborhood Technologies sustainability metrics handbook to inform a recent planning workshop.

A major enhancement over existing software packages is the addition of pop-up windows for each sustainability indicator that explains the theory behind each indicator, the connections between the indicator and livability
concerns, and links to design solutions via hypertext links to online sources and a bibliography.

C. The Sustainable Places Project Browser and Participatory Engagement Template System

Once a community has completed a design workshop process and created 2-4 alternate development scenarios for its downtown or other focal area, the question is how does a community get by-in from its public to that envisioned future, and engage the public in a dialogue on those planning results in a meaningful way. To address this issue, the CATS consortium contracted with the Texas Advanced Computing Center (TACC) to create an on-line public engagement software system where products from charrettes can be easily ported to a web template for on-line public participation. A second objective is to take the ET software in a more limited fashion into a web based browser environment so citizens can explore "what if" scenarios themselves for their city. Although it was not expected, the TACC and the Center for Sustainable Development have developed a method to export alternative scenarios into ESRI's city engine 3D modeling system to enable high quality 3D visualizations on the fly in workshop settings. Although analytics are important to inform future land use and infrastructure discussions, three dimensional models often are even more persuasive as a picture is clearly worth a thousand words or graphs.

D. The Sustainable Places Project Into The Future

Perhaps the most important part of this project from the CATS Consortium perspective is the shared interest in growing the software system well beyond the end of the HUD grant period in 2013. It is hoped that the system will continue to evolve and grow eventually into the open source GIS environment through a new wiki system. There is strong interest among the Consortium members to seek out additional grant funds to refine and improve this evolving software system.

References

1. The project team consists of many UT faculty and centers. This essay is written by the CSD faculty. The project team from the UT CSD comprised of Dr. Robert Paterson (PI), Dr. Michael Oden, Dr. Elizabeth Mueller, Dr. Ming Chun Lee, Dr. Ming Zhang and doctoral students Thomas Hilde and Marla Torado, MS CRP students Nathan Brigmon, and ACC Faculty Member Sean Moran.


10. Between 2006 and 2009, the Trust for Public Lands, CAPCOG, The University of Texas, and City and County governments in the Central Texas region undertook a Greenprinting process (i.e., open space and preservation lands suitability mapping) taking into account lands necessary to protect water quality (especially riparian zones) and quantity (i.e., karst recharge areas); ecologically sensitive areas such as endangered species habitat; prime farmlands and ranches; important recreational resource lands; cultural and historic sites, and scenic corridors to assist localities in defining priority lands for protection from land development. The project created an interactive GIS map system that enables state and local governments to query land development and infrastructure development proposals against the regional open space maps to prioritize protection programs and measures; to avoid water, sewer, and transport infrastructure decisions that would conflict with the green infrastructure plan, and to enable acquisition of the highest priority lands as development in the region continued. See summary at: http://contextsensitivesolutions.org/content/case_studies/central_texas_greenprint_for_gr/