Integrating IT Tools to Assist Local Stakeholders in Open Space Decisions

Douglas F. WUNNEBURGER & Buren B. DEFEE II

Ph.D. Douglas F. Wunneburger; Buren B. DeFee II, GeoInformatics Studio, College of Architecture, Texas A&M University, College Station, Texas, USA, d-wunneburger@tamu.edu

1 INTRODUCTION

As the population in Texas grows, citizens of the seven counties within the Brazos Valley Council of Governments (BVCOG) have recognized the likelihood of encroachment from spreading urban centers into heretofore-rural areas. Some of this spread will come from within the area of the BVCOG, notably Bryan and College Station; however, higher impact is likely to come from major population centers outside the BVCOG such as Houston and Austin.

In a decision of substantial foresight, the Environmental Subcommittee of the BVCOG sought to address issues of urban sprawl through the development of an Open Space Inventory. Originally, the sole request of the subcommittee was for the development of a GIS database of existing and potential open space areas within the seven counties. Several problems were identified with this approach. Notably:

- Open space is poorly defined and largely dependent on local values.
- Appearance of *outside experts with answers to local problems* will alienate many stakeholders within the BVCOG threatening local participation in the project.
- A mechanism for delivering information is as important as the open space inventory database, itself.

To address these issues as well as to develop the open space inventory database, the GeoInformatics Studio is developing an Internet-based open space decision support system. This system will provide a means to identify existing open space areas, assess areas for need of additional open space, and allow interjection of local citizen values in determining what areas to consider for conservation. Ultimately, the system will rank areas within the BVCOG quantitatively for desirable open space characteristics based upon these existing resources, identified needs, and expressed local values.

2 JUSTIFICATION

In 1996, Texas was the second most populous state in the United States with an estimated population of over 19 million people. Recognizing the rapid growth within the state, the Brazos Valley Council of Governments (BVCOG), a 7-county regional planning organization decided to take steps to preserve open space against future growth. Current population data from the Texas State Data Center (TSDC) support their concerns about growth. A study of TDSC estimates reveals the following:

- Of the 254 counties in Texas, 5 of the top 20 fastest growing counties are within 50 miles of the BVCOG. Between 1990 and 2000, all 5 experienced growth rates over 30%)
- Six Texas counties of the highest 20 in numerical increase in population fall within 50 miles of the COG (Harris, Travis, Fort Bend, Montgomery, Williamson and Bell).
- In the year 2000, seven of the top 20 most populous counties in Texas fell within 50 miles of the BVCOG (Harris, Travis, Fort Bend, Montgomery, Williamson, Bell and McLennan).
- Six of the seven counties within the COG are over the average statewide population growth rate of 10.21%, with the highest rate almost double.

Demonstrated growth and potential future growth are not always strong enough arguments for open space preservation. In a study of economic benefits of open space preservation, the Western Governor's Association in partnership with the Trust for Public Land identified 19 key areas. These include:

1. General Valuation and Economics
2. Property Values
3. Business Relocation
4. Private Investment/Commercial Development
5. Urban /Downtown Revitalization
6. Community /Neighborhood Revitalization
7. Health Benefits
8. Jobs
9. Tourism
10. Crime Prevention
11. Government Agency Expenditures
12. Recreation and Spending
13. Costs of Open Space vs. Developed Land Uses
14. Infrastructure
15. Flood Control / Hazard Mitigation
16. Urban Forests / Trees
17. Market for Open Space
18. Innovative Use of Land
19. Economic Benefits for Private Landowners

Evidence of current growth and the potential benefits of open space planning provide the impetus for moving forward with an open space plan. However, choosing a method for identifying appropriate areas to designate can be difficult. Open space is ill defined. Local values may greatly influence areas that constitute such a designation. Hiring an expert may result in a plan that is environmentally sound, but may not meet the perceived needs and desires of the local populace. Planning by commission may introduce unwanted political conflict into the process. Planning by advocacy may reflect the desires of the populace, but may lack the political clout to preserve enough land to be environmentally responsible.

3 ENABLING INFORMATION TECHNOLOGY IN PUBLIC DECISIONMAKING

In order to address limitations of current alternatives to open space preservation, the GeoInformatics Studio at Texas A&M University is developing an Open Space Decision Support System (OSDSS) for the BVCOG. Currently, substantial efforts toward spatially enabling geographic information technology on the World Wide Web are underway (OGC 2000). Recent studies employing such Internet-based spatial tools in support of community planning indicate great potential. Howard (1998) and several others (Shiffer 1995, Hundt 1997, Krygier 1998, Pieplow 1998) support the use of geographic information technology in participatory activities for public planning. Dandekar (1982) suggests three modes of communication help to stimulate ideas and build consensus: presentation of information to the public; receipt of information from the public; and exchange of ideas and opinions that build upon shared information as ideas evolve. Increasingly, the Internet serves as an appropriate medium for disseminating spatial information to public users (Evans 1999).

Each of these modes is addressed within the OSDSS and they are delivered through the World Wide Web. The most advanced of current offerings of internet-based GIS provide the capability to deliver current, distributed data of varying sources, formats and map projections. Within the OSDSS, capability goes one step farther. By executing real-time, server-side models based upon parameters determined by local citizen values, the interactive system allows individuals or committees to submit preferences on-line and observe quantitative representations of what-if scenarios implementing those basic values.

Through implementation of the OSDSS, decisions can be based on environmentally sound principles and geographic facts. Backed by the regional planning organization and the local populace, it carries enough political clout to accomplish larger planning goals. To foster local support, a survey of local values is integrated into the decision support system and incorporates such information to generate rankings for potential areas of preservation. Furthermore, poor planning due to political concerns is limited by providing a quantitatively unbiased system for determining potential sites. Components required for building such a system include a combination of survey, mapping and analysis software, and methods for receiving information and distributing results. To reach the largest possible audience, integrating Internet access into the OSDSS provides a method for interactive participation of concerned individuals and groups.

3.1 OSDSS Implementation

Fundamental to development of the Open Space Decision Support System are four steps: assembly of appropriate geographic data, development of software, input of citizen values, and distribution of results.

3.1.1 Geographic Data Sources

Geographic data collected for this project come from a variety of sources, including pre-existing data, such as road, hydrology, aerial photography, and political boundary layers. Other geographic data must be generated for use with the system, including buffer zones and land-use classification. Collecting and combining a variety of data presents the first hurdle to the OSDSS. Though several layers exist for inclusion in the system, disparate vendor formats and map projections must be normalized. Fortunately normalization is accomplished through GIS software. Figure 1 shows a selection of data providers and their respective GIS operating environments.

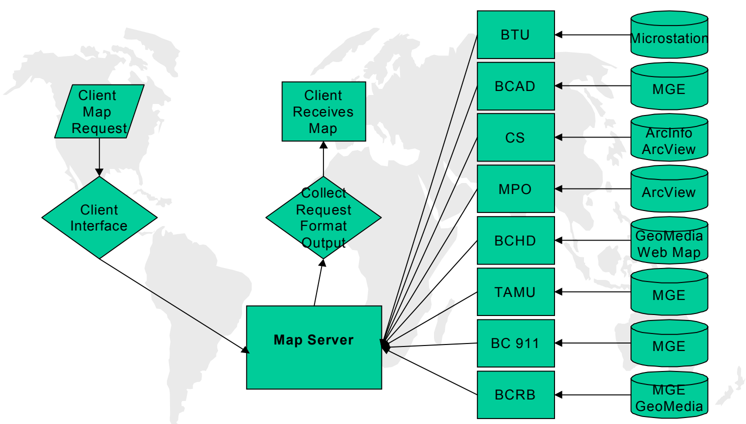

Figure 1: Brazos County GIS data sources and operating environments

Table 1 shows the various map projections employed in one of the seven counties.

- City of Bryan, Brazos County
  - State Plane, TxCentral, NAD-27, feet
- City of College Station, BCSMPO
  - State Plane, TxCentral, NAD-83, feet
- TAMU
  - State Plane, TxCentral, NAD-83, meters
- Texas Department of Transportation
  - Lambert Conformal (Shackelford), NAD-27/NAD-83, feet/meters
- Texas Digital Orthometric Quadrangles
  - UTM, Zone 14, NAD-83, meters

Table 1: Brazos County GIS map data projections

3.1.2 Software Development

The user interface is developed using a variety of software packages and programming languages. The foundation for mapping user preferences is being constructed in Geomedia Professional. This GIS provides the ability to integrate data layers originally created in a mosaic of software environments (Figure 1) and geographic projections (Table 1). These data layers will be kept in their original formats. Hence, no user errors are introduced through conversion or reprojection. Also, the respective owners of the various data maintain the supporting database layers. To facilitate the need for public interaction and widespread distribution, a web-based tool provides the mechanism to collect user preference data, provide this data to the GIS, and subsequently display the results of the models. The website is constructed primarily with HyperText Markup Language (HTML). Microsoft Access database interaction and GIS views are programmed using Active Server Pages (ASP). Javascript is used client-side interaction with Geomedia Webmap. Figure 2 shows a schematic of the OSDSS.

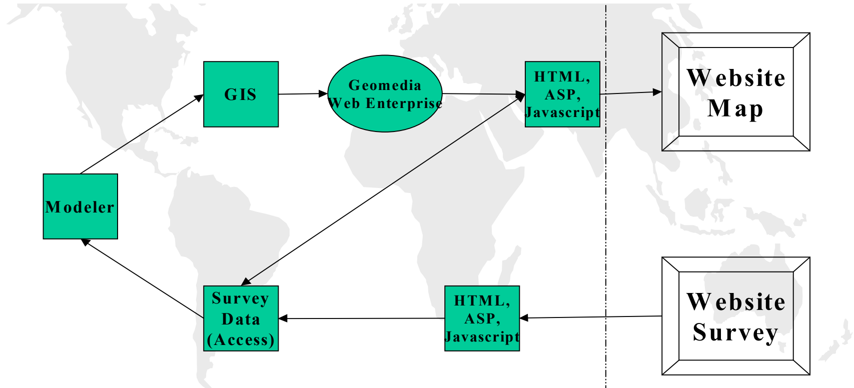

Figure 2: Schematic of OSDSS web implementation

3.1.3 Citizen Input

Survey information is collected when a user enters the Website. This information includes user preferences about the landscape as well as the geographic location of interest to the user. The data collected is stored within a server-side database accessible by the GIS and modeling software. Figure 3 shows a representative questionnaire form. After completing the survey, the modeling software will determine which lands are within the defined spatial boundaries and which match the user's criteria. Base data layers are displayed with the areas produced from the model clearly marked. The web interface to the GIS provides a highly interactive view, allowing users to zoom in and out, pan across the map at any zoom level and turn data layers on and off. Because the modeling is based partially on user preferences, these preferences can be changed if the model results are deemed unacceptable. Should the questionnaire require modification in the midst of the decision process, an on-line form provides the ability add, update or delete questions (Figure 4).

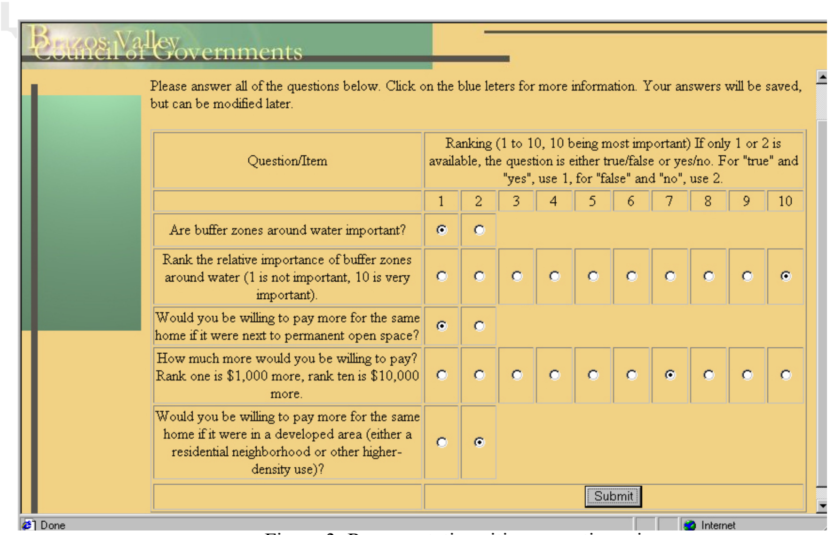

Figure 3: Representative citizen questionnaire

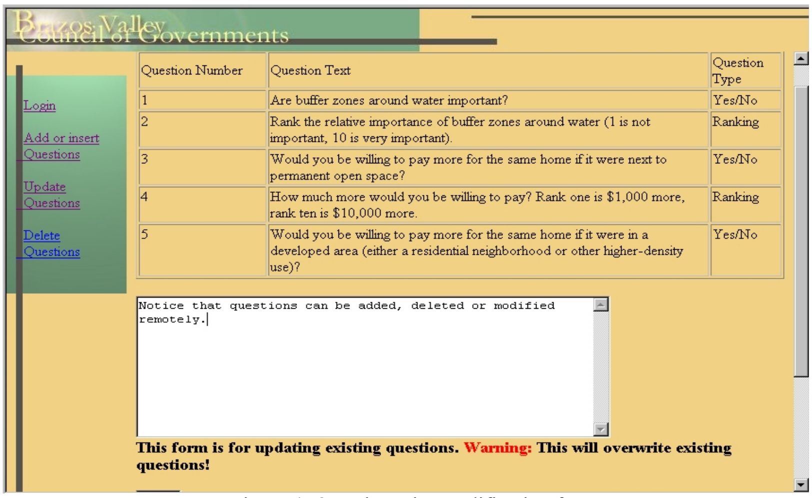

Figure 4: Questionnaire modification form

Upon full implementation, we anticipate the OSDSS being used by local citizens to provide input for the decision-makers. The OSDSS will allow the decision-makers to view individual as well as mean citizen input, both numerically and spatially. Decision-makers will be able to utilize this input while collaborating in meetings to decide which criteria are most important for open space. Furthermore, new qualitative basic values can be input interactively, allowing quantitative representation of landscape scenarios.

3.1.4 Distribution of Results

The final list of criteria will be input into the OSDSS to producing a map ranking (Figure 5) the land parcels according to the criteria and indicating the viable parcels for open-space consideration. These mapped scenarios can be stored permanently within the system, available to export for use in other GIS, and exportable in digital image format for inclusion in other report and map documents.

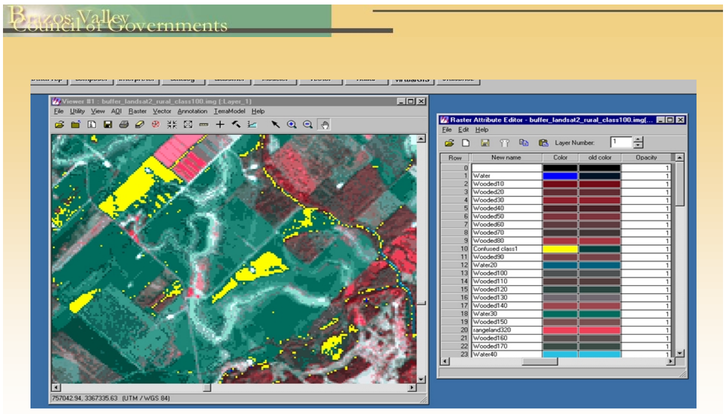

Figure 5: Representation of ranking scenario

3.2 OSDSS Testing

Testing of the OSDSS implementation is scheduled to begin during Spring, 2001. Two types of evaluation are planned. Initially, the conceptual system model (Figure 6) will be tested iteratively. Subsequent studies of the user interface, the validity of user generated models and general user understanding of the processes for determining open space will be evaluated.

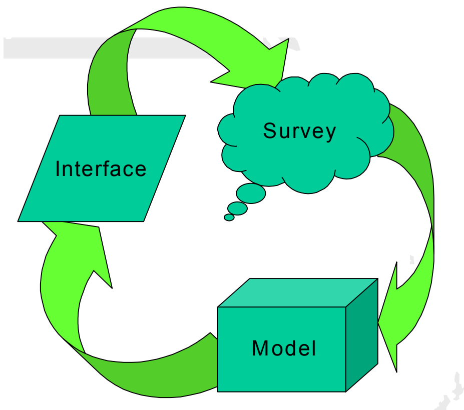

Figure 6: Conceptualization of iterative testing methods

4 SUMMARY

Computer systems have been used for many years to support decision-making in public forums. Advances in computer and projector technology have made the computer the media of choice for many presenters, displacing older technologies such as slides, transparencies and even chalkboards. But the computer has a longer history in public forums, being used to provide much of the information to support the decision process. Data collected in the field or compiled in a model has found its way into these forums through statistics, graphs, charts and maps – all functional forms of communication. Many future decisions will be based on computer models, thus the need to investigate their shortcomings and how they may be addressed.

There are some basic factors that affect computer models whether they are being used for research or to support decision-making in private or public forums. The first is the question it is being designed to answer and the questions that must be answered before the model can be built. The correct questions must be posed for any computer model to be accurate or even relevant. If the public is to be included in the decision process, many questions must be asked of the public. This can be accomplished through printed or online surveys or through focus groups. Accessibility is key when including the public. Just as important as accessibility is clarity. It is possible that the persons participating in the forum are not experts in that particular field, thus the questions may contain terminology unfamiliar to the participants. The researchers must either simplify the question or define the terms. This can be difficult to do without introducing bias.

When modeling an environment, the data upon which the model is built must be both relevant and accurate. Missing relevant data can skew the results in an unintended manner. Additional irrelevant data may do the same. Accurate data is always important. How accurate is dependant upon the scale of the project. If the forum were about a city easement, the parcel data would need to be accurate to within a few inches. Larger scale decisions, such as open-space preservation, can have a bit more leeway in their accuracy. Prior consultation with the client(s) to define the scope of the model is a necessary step to ensure relevancy and accuracy.

Public forums introduce some interesting aspects to modeling. As the models are demonstrated, questions from the participants may indicate a need for more data, less data or a change in the relationships between data. Currently, this requires researchers to return to their computers, make changes, print out relevant material (whether in the form of printed maps, slides, or power-point presentations) and schedule another forum to discuss decisions based on the new changes. Bringing the hardware to the forum is a potential solution, but is fraught with difficulties.

Moving the system is always a risky prospect unless everything is housed on a computer designed for the rigors of travel, such as a laptop computer. However, because laptops are designed with portability in mind, affordable systems lack the storage space to contain the data and the processing power to manipulate the data, thus are impractical for systems modeling and decision support. Moving a desktop computer used to house the modeling system is another solution, but this is fraught with its own difficulties. Desktop computers are designed to remain in one place and moving one often can result in hardware problems and subsequent loss of data. New software and programming techniques are addressing these problems.

"Thin" clients running on portable computers allow access to software and data on a server. A "thin" client is a less complex, more generic piece of software that is designed to run on a remote system, while accessing the more complex software that resides on a server. A good example of a thin client is a web browser such as Microsoft Internet Explorer. Internet explorer has the ability to access many different types of software located on servers running different operating systems. This means that Internet Explorer is oblivious to the server's operating system and it does not matter if the server is running Unix, Linux, Microsoft NT or other server software.

New software is taking advantage of "thin" clients and providing the tools to deliver complex, server-side data to any computer with a web browser. Properly designed Websites with the appropriate support software can interface with databases and GIS to support data distribution, data collection and data manipulation. In a public forum, a laptop computer with a projector and a connection to the internet can act as a thin client, allowing the distribution of relevant information, the collection of additional data, interaction with a model, and even manipulation of the data relationships within that model.

This is not, as some would think, the Holy Grail of public forums. There are still some difficulties associated with this solution. Even though the presenters may spend a great deal of time making the system user-friendly, there will be people so unfamiliar with basic computer skills, the system will still be foreign to them. Not all facilities are designed to adequately support projection systems. Not all facilities will have adequate phone lines for Internet connections. Finally, there may not be adequate time for productive interaction, thus requiring an additional forum to finish the process.

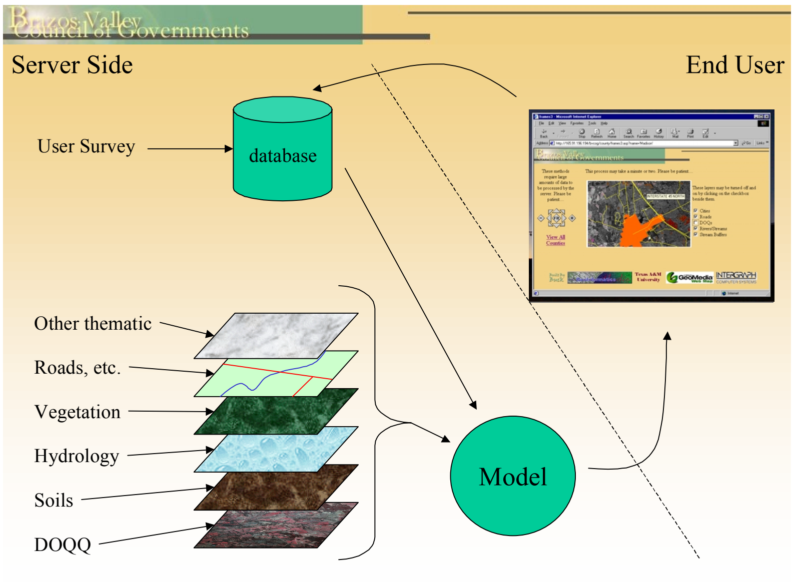

Figure 7: Conceptual representation of OSDSS

"Thin" clients are a good solution for bringing computer modeling into public forums. With any new technology come some new difficulties. However, some of these problems are just old problems (such as inadequate facilities for presentations) with a new twist. Only time will tell if the new methods bring greater understanding and better decisions than the methods used before.

5 REFERENCES

DANDEKAR, H. ed.: The Planners Use of Information. Stroudsburg: Hutchinson Ross Publishing Co. 1982.
EVANS, A., R. Kingston, S. Carver, I. Turton: Web-based GIS used to enhance public democratic involvement; http://www.geog.leeds.ac.uk/research/papers/99-1/. 1999.
HOWARD, D.: Geographic Information Technologies and Community Planning: Spatial Empowerment and Public Participation; Project Varenius Specialist Meeting. 2000.
HUNDT, K.: Futurescape: Chattanooga's Community Planning Process; Urban Land. Vol 56 No. 9. 1997.
KRYGIER, J.: Public Participation Visualization: Conceptual and Applied Research Issues; http:///www.geog.buffalo.edu/~jkrygier/krygier_html/lws/lws_content.html. 1998.
OGC (Open GIS Consortium): Spatial Connectivity for a Changing World; http://opengis.opengis.org/wmt/. Oct. 19, 2000.
PIEPLOW, B.: Using Multi-Media Technology to Build Public Consensus; Planners Casebook.Vol 25. 1998.
SHIFFER, M.: Environmental Review with Hypermedia Systems; Environment and Planning B: Planning and Design. Vol. 22, pp. 359-372. 1995.