Geog 464 Learning Objective Outline

LOO 25 Future Directions for GIS-based Decision Support
25.1 How well is GIS technology addressing growth management and sustainability concerns and what might we expect in the future?
25.2 How does stakeholder public participation connect with advances in GIS for sustainability management?
25.3 What is the future of online platforms for decision support?

25.1 How well is GIS technology addressing growth management and sustainability concerns and what might we expect in the future? *RUGIS* Chapter 14. Section 10.4

There is no doubt that GIS can support growth management and sustainability management at this time. However, full support for all analysis and management is not yet possible for most commercial GIS. It is a matter of marketplace recognition, which is still to come. We develop the capabilities of GIS to address growth and sustainability management in using database management, spatial analysis, and mapping/geovisualization technologies.

Integrated database management is possible. Establishing links among planning, improvement programming and project implementation databases is certainly possible given the current technology. The challenge is to get different parts of organizations to collaborate on their database designs, as each decision situation has its own decision requirements.

The biggest obstacle for growth management is characterizing change over time, but it is possible to design databases that consider temporal dimension. In chapter 2 we discussed a nuanced workflow process developed by Steinitz and his colleagues (2003) now called geodesign (Steinitz 2012).

a) Representation model development is undoubtedly a GIS-based activity, as databases are foundational to GIS work. Integrated databases are important, as it makes sense to inter-connect what were once “data silos” to more enterprise solutions in data warehouses, and even federated distributed data management solutions.

b) Process models have been better implemented through specialized software, but GIS software applications are beginning to recognize temporal data processing issues. Spatio-temporal modeling, e.g., land use change overall multiple increments of time, can be done as time slices, whereby the analysis of process is depicted as a visual animation. This step in modeling might be considered the last major hurdle for implementing full-on geodesign decision support.

c) Evaluation, change, and impact modeling are readily performed using GIS software, and there are many application software available.

d) Decision modeling is possible, but requires a bit of work to implement specialized solutions and GIS vendors have not yet fully adopted a variety of them for application. Customizing dashboards are a way forward with this effort. GeoPlanner provides a great example of dashboard.

Applications to support planning, programming, and project implementation decision situations exist and will grow. GIS, as an information technology, and particularly a decision support technology in a broad sense is expanding in a number of ways. Building on data management, spatial analysis, and map visualization technologies, with other technologies is also very popular.

Monitoring events in support of real-time GIS is becoming an important application. Events could be habitat ecosystem characteristics and/or people related events like real-time traffic congestion. This might be called operational activities, that which occurs day to day. Routing workers in the field to fix pot holes; or picking up old refrigerators routed on a day to day basis is another.

3-D visualization software like that in the St. Mary's Georgia project - Visual Nature Studio3® for creating spatially referenced photorealistic 3-D scenes from each scenario – is becoming more popular because it is easier than before. Three-dimensional visualization software that implements smooth animation, as in "map movies", makes it easy to show change within scenarios.

Enhancing geospatial information technology to support more diverse audiences is another growth area, e.g. as in the public realm; this relies on communications technology, decision science technology as well as data management, spatial analysis, and map visualization.

25.2 How does stakeholder public participation connect with advances in GIS for sustainability management?

When we broaden the topic of group decision support to public decision support then we start to address fundamental issues in the democratization of decision processes. Considerable research is underway to place GIS in participatory contexts, whether it is called participatory GIS - PGIS (Harris et al. 1995, Jankowski and Nyerges 2001, Nyerges and Jankowski 2010) or public participation GIS - PPGIS (Nyerges 2005; Nyerges, Barndt, Brooks 1997), community integrated GIS (Craig, Harris, and Weiner 2001), or participatory CyberGIS (Nyerges, Roderick and Avraam 2013, Nyerges et al. 2016).

Regardless of the label, individuals as part of the public and groups within the public are often marginalized in public decision processes; while at the same time scientists have had challenges working together because of the deep, siloed, and diverse knowledge they hold. When examining an ability to give public voice in democracy, marginalized voice is a fairly pervasive problem. Practically speaking, society is constituted of many diverse groups – even if we consider the public as *whole*.

Despite many federal, state, and local laws that require public participation, research about local governance indicates that large-group participation in publicly-oriented decisions is a challenge when it comes to *meaningful participation*. Meaningful participation can be defined in terms of *access to voice* (a deliberative process) and *competence of knowledge(s)* (an analytic process) that fosters *shared understanding* about values, interests, and concerns that underlie the recommendations/choices to be offered/made by those with a stake in the decision (National Research Council 1996). Meaningful participation is a hallmark of a healthy democracy, particularly deliberative democracy in comparison to representative (make a vote) democracy.

Deliberative democracy involves empowerment wherein a reasoned discussion among people promotes shared understanding on a topic followed by consensus building. Although interest in deliberative democracy has existed for over 100 years (Gastil and Levine 2005), research and practice since the late 1980's has blossomed. Over the past decade, hundreds of deliberative democracy events of varying sizes have occurred across the world. A synthesis of case studies appears in a *Deliberative Democracy Handbook* (Gastil and Levine 2005). Several of the chapters deal with location-based issues and thus GIS could be useful. However, no chapters actually refer to GIS, a seeming disconnect and latent opportunity.

Research about *analytic-deliberative decision processes* has shown that meaningful public participation is possible and decision outcomes are improved (National Research Council 1996, Nyerges and Aguirre 2010). The *analytic component* provides technical information that ensures broad-based, competent perspectives. GIS has provided technical information in such processes as maps can represent changes in landscapes. The *deliberative component* provides an opportunity to give voice to choices about values, alternatives, and recommendations. Unfortunately, such public participation has been expensive and time consuming, and involved small to medium-sized groups (10-15 people). Working through analytic-deliberative participation in small to medium-sized groups in face-to-face settings is a start, but scaling analytic-deliberative participation out to include large groups is a challenge and scaling up as from local to regional domains is also a challenge; but scaling out and up matters.

Whether groups are better supported in face-to-face or online settings is still an open research question. Both face-to-face and online settings are advantageous for their special reasons: richness of exchange versus convenience of getting together. Both will continue to grow with GIS use expanding.

Participation comes in various forms. Online platforms that combine GIS data management, spatial analysis and geovisualization technologies, together with decision modeling and communications technologies can form various types of platforms. A development that has come on strong in the past several years is called "volunteer geographic information (VGI)". A couple of newer successful projects have been Open Street Map and Ushahidi. "Open Street Map" project in the United Kingdom is one wherein people wanted to contribute their insights to how the transportation system in various UK (and now more broadly European as well as across the world). Ushahidi is an interactive mapping software project credited with helping in the Haiti earthquake disaster. These are called "mashup" software, and focus on "situation awareness" as a contribution to decision making, originally started by the Google Maps as a mashup platform. Such applications can feed the front-end of the decision support process; that is collect information about what people might want to know. Such applications require a workflow decision process to really make use of all the information. An example online platform that involves structured participation for decision making by groups is the Let's Improve Transportation (LIT) website (www.letsimprovetransportation.org). Societal trends continue to emerge that suggest more and more people do care about the sustainability of their communities. GIS can help shed light on directions through new distributed platforms.

The integration of geographic information across space-time decision scales is continuing to form a foundation for addressing growth management and sustainability concerns in the 21st century. Web-based information technologies are developing so quickly that it is clear that GIS implemented with such technologies will make an even greater impact on society in the future. Web services for data, analysis, and display are being developed, deployed, and used by those who want to make a difference.

Individuals, groups, organizations (private and public), and communities (collections of the formed) will collectively decide what gets done with development and use of the GIS of the future. There is no doubt at this point that GIS will continue to develop in many ways based on those collective directions.

25.3 What is the future of platforms for decision support?

Some examples of more recently (re)developed client server platforms are:

Geodesign Hub for collaborative geodesign developed by Hrishi Ballal and Carl Steinitz

GeoPlanner within ArcGIS Online from esri

EMDS – integrates multiple software engines to create a multi—functional spatial decision support environment; many publication citations reporting on its use are available at the Wikipedia site.

Composing workflows that connect ensemble models and data remains a major challenge of data resource harmonization, that is, to get models and data to perform in unison for a particular task. This is an age-old inter-operability problem. New work is looking at decomposing workflows into tow or three tiers:

1) Stakeholder user workflow involving composition of high performance (analytic-deliberative) collaboration resources, focusing on the deliberative workflow
2) Decision analyst workflow involving composition of analytic decision tools that support analytic processing
3) High performance computing workflow that supports the deliberative and analytic processing

How this at plays out as a contribution to society is a matter of human ingenuity, hard work, and convincing others that GIS and Decision Support matters.