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# OHIO'S USE OF GEOGRAPHIC INFORMATION SYSTEMS TO DEMONSTRATE PUBLIC PARTICIPATION IN THE REDISTRICTING PROCESS

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## I. INTRODUCTION

A Geographic Information System ("GIS") is an important redistricting tool used to create the database required to draw boundaries, build district plans, and evaluate alternative plans based on a set of criteria. These functions are achieved as a result of more powerful computers, user-friendly software, and the public availability of databases needed for drawing boundaries of political districts that meet multiple criteria.

Redistricting often takes place in political backrooms, with politicians and consultants making partisan political decisions. Many believe the process should be brought into the open, and that the "fairness" of the outcome could be improved if redistricting plans were judged by widely-accepted criteria. Although much attention is paid to the importance and measurement of various criteria of fairness, advanced GIS-related technologies promise the greatest potential for democratization of the redistricting process because they offer a way for more people to recommend, propose, and evaluate redistricting plans. The issue of who can make recommendations for district boundary plans and who can evaluate such plans is as important as the criteria and the plans themselves.

This Case Study examines the Ohio redistricting contest. In the contest, the Ohio Secretary of State and others tested the feasibility and merits of opening a GIS redistricting system to public

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participation with the aim of developing alternative district plans. These plans were to meet several objectives concerning fair and competitive elections. Ohio's experience provides some indications about how GIS will and should play a role in future redistricting.

## II. THE OHIO SECRETARY OF STATE'S REDISTRICTING COMPETITION

In 2009, in partnership with several interested organizations and experts,[1] Ohio's Secretary of State ("SOS") undertook a project in the spring of 2009 to test and evaluate a presumably fairer process of redistricting that would be open to the public.

In Ohio's existing process of redistricting, congressional districts are drawn by the General Assembly through legislation. Other than federal case law on equal population[2] and minority representation,[3] there are no rules or criteria to meet. For simplicity, the SOS's project addressed only congressional redistricting.

The project provided for open competition with one key inquiry: whether persons with access to software, data, and some limited training could create districting plans that achieved a number of goals concerning criteria thought to contribute to a fair districting plan. It was assumed that a "good" redistricting process would achieve the following goals—preserving Ohio communities, promoting political competition, accurately reflecting the political leanings of the electorate, and providing an open and transparent process.

Because data for 2010 were not available, the competition used a precinct-level database from the state's 2001 redistricting data program. Some modifications to the database were necessary, including smoothing some highly irregular coastal boundaries and combining islands in Lake Erie to reduce the possible impact of such areas on compactness scores.

Software and data were supplied by The Ohio State University ("OSU") via Terminal Services.[4] Thus anyone with an Internet connection could access and use the required resources. ArcGIS, with

1. Partners included former state Representative Joan Lawrence, the League of Women Voters of Ohio, state Representative Dan Stewart, Professor Richard Gunther of the Ohio State University, Ohio Citizen Action, and Common Cause Ohio.

2. Reynolds v. Sims, 377 U.S. 533 (1964); Baker v. Carr, 369 U.S. 186 (1962).

3. Shaw v. Reno, 509 U.S. 630 (1993).

4. Terminal Services is Microsoft's implementation of thin-client terminal server computing. Windows applications are made accessible to a remote client machine.

its districting software extension, was used as the GIS software.[5] Users registered with the SOS to receive user accounts and to access the system, and approximately eighty accounts were created.

Cleveland State University ("CSU"), which provided the database and its modifications, also added customized utilities that computed measures of compactness and county fragmentation to the ArcGIS application.[6]

CSU also provided training and a manual on how to access the OSU system and how to use the GIS functions and districting tools to complete and submit a plan. A one-day training workshop was held in Columbus, Ohio. A video of the training was made accessible on the SOS Web site,[7] along with the manual and other information about the competition. CSU also provided technical assistance over the phone and by email, scored results for each participant, and produced final maps and results for the SOS.

Three threshold conditions had to be met before other criteria were scored:

- <u>Population equality:</u> Each district had to be within 0.50% of the average population of all districts.
- <u>Contiguity:</u> Every part of a district had to be reachable from every other part without crossing the district's borders. Overlaps or gaps between districts were not allowed, and the entire state had to be covered. Water contiguity was permitted for districts containing Lake Erie islands.
- <u>Minority Representation under the Voting Rights Act</u>: All plans had to provide for at least one majority-minority congressional district.

Once these three conditions were met, plans were evaluated using four additional criteria:

- <u>Compactness:</u> Compactness was measured by the ratio of district area to the square of its perimeter.

5. ArcGIS is a GIS software system provided by the Environmental Systems Research Institute (ESRI). For a description of this software system see http://www.esri.com/products/index.html (last visited Apr. 28, 2010).

6. Early planning of the project included counting the fragmentation of municipalities, but this was later dropped from the competition criteria.

7. Ohio Redistricting Competition, http://www.sos.state.oh.us/SOS/redistricting.aspx (last visited Apr. 1, 2010).

- Representation of Communities of Interest: For simplicity in this demonstration project, communities of interest were counties. A community of interest was "fragmented" when a county was split into two or more districts. Two exceptions to counting fragments were made. Districts that were entirely within one county were not counted as fragmenting the county. In addition, a few cities, including Columbus, cross county boundaries. Splitting a county into multiple districts to keep a city together did not count as fragmenting the county.
- Competitiveness: This measure sought to maximize the number of legislative districts that could be won by either party as measured by the percentage difference in votes in a district for Democratic and Republican presidential candidates in the 2000 election. There were four categories of competitiveness, ranging from very competitive to not competitive.
- Representational Fairness: This measure compared the difference between proportions of statewide votes for the political parties in recent elections with the congressional seats likely to be won by those parties.

Each criterion was assigned different weight. Compactness and communities of interest were deemed to be twice as important as competitiveness and representational fairness.

The competition began on April 10, 2009, and concluded on May 11, 2009. Though some eighty user accounts were requested, only fourteen plans were submitted. Three were disqualified because they did not meet all of the threshold conditions concerning a majority-minority district, equal population, and contiguity.

Three plans with the highest scores were declared the winners. As an example of the results, one winning plan had the following characteristics:

- nine Republican-leaning and nine Democratic-leaning districts,
- eleven competitive districts,
- twenty county fragments, and
- the sixth highest compactness ratio.

For comparison, the current congressional plan for the state has these characteristics:

- thirteen Republican-leaning and five Democratic-leaning districts,
- seven competitive districts,
- forty-four county fragments, and
- a compactness score lower than all of the submitted plans.

According to these criteria, all three winning plans were superior to the current congressional district plan. In fact, even the worst-scoring plan submitted in the competition was quantitatively "better" than the redistricting plan implemented in 2001.

The competition was judged a success by the SOS, its partners, and others, though everyone also recognized that improvements would be necessary should a similar redistricting process be put into practice for the state.

## III. WHAT MORE NEEDS TO BE DONE?

The next round of redistricting is imminent. Within a year, the Census Bureau will release the redistricting database for each state. States like Ohio are using GIS to prepare databases of election results that will be merged with the census data—but only after adjusting for geographic discrepancies and estimating some data.[8]

Industry-standard commercial GIS software does not provide the specialized decision support tools for calculating the various metrics for criteria of fairness and competition noted here, though this software provides the user with tools to build them. Often such tools are add-on, user-requested modules or "extensions" that use the basic GIS engine to customize the application. At times the specialized application is all that the user sees, though it sits on a more generalized GIS. Several PC-based software systems exist that enable users to build of district geography while summing population and election results data. Web-based systems offer the possibility for greater public participation in the process.[9]

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8. Boundary adjustments and population estimates are often necessary because the precinct-level data delivered by the Census Bureau is not necessarily accurate or sufficient. The Census Bureau's deadline for submitting precinct boundary data meant that states submitted precinct boundary data in 2009, presumably reflecting voting districts as of the fall 2008 elections. If states want to use election results from the fall 2010 election, they will have to estimate population data for precincts that have changed.

9. *See* ESRI, Districting for ArcGIS, http://www.esri.com/software/arcgis/

There have been significant advances in redistricting data and technologies over the last two decades. The Census Bureau, for example, now allows states to provide precinct boundaries even if they split previously established census blocks. GIS facilitates estimating data where necessary. GIS-based districting software advanced significantly between 1990 and 2000 and has continued to improve in functionality and ease of use. Web-based application of the technology is a major improvement over the possibilities offered ten years ago, when public participation was limited to the few who had access to a PC loaded with the necessary software and data.

So what more is there to be done? I suggest four areas of needed improvement: the user interface to the software, integration of the computations of criteria metrics with the district drawing function, web-based availability, and changes in how the data are produced.

*User Interface*

Software is the most obvious area for improvement. The user interface determines how easily a non-expert in GIS can use the application. Most of the software systems have been designed as extensions of GIS software for which users require several days of workshop training to become minimally proficient. The number and complexity of functions that may be useful for districting are daunting to the novice.

The Ohio competition proved that with the proper tools and training, a novice can produce a redistricting plan. But it also showed that the task was very difficult, took many hours, and caused considerable frustration among even the most proficient participants. While fourteen plans were submitted by twelve persons,

extensions/districting/index.html, (last visited Apr. 5, 2010) (featuring the "Districting for ArcGIS" extension, an example of an add-on module to a more general GIS); Citygate GIS, AutoBound 9, http://www.citygategis.com/redistricting.htm (last visited Apr. 5, 2010) (featuring AutoBound 9, which uses ArcGIS as its GIS engine); Caliper Corporation, Maptitude for Redistricting Software, http://www.caliper.com/mtredist.htm, (last visited Apr. 5, 2010) (featuring an application that, though sold as its own application, uses Caliper's Maptitude GIS as its engine and "Maptitude Online Redistricting – Public Edition" as its web-based redistricting software that enables public participation in submitting district plans); Corona Solutions, GeoBalance, http://www.coronasolutions.com/products/geobalance.shtml (last visited Apr. 5, 2010) (featuing a system that was not built on a more general GIS engine and was designed for police district plans, but is suitable for political districting). For examples of other software systems, *see also* Dave's Redistricting App, http://gardow.com/davebradlee/redistricting/launchapp.html (last visited Apr. 5, 2010), and United States Election Project, BARD: Better Automated Redistricting, http://elections.gmu.edu/Redistricting.html (last visited Apr. 5, 2010).

approximately eighty accounts were set up, possibly indicating that many persons who wanted to participate could not. CSU also provided approximately eight hours of telephone and e-mail consulting with participants to clarify steps and functions, and another twenty-four hours making corrections to submitted plans with minor errors attributable to user inexperience. These corrections included adding omitted areas to districts where they were obviously intended.[10] Persons familiar with GIS can readily learn to use GIS-based redistricting applications software, but the Ohio experience shows that there is a long way to go before almost anyone can participate in the process without much difficulty.

*Integration of the Criteria Metrics*

For the next round of redistricting, GIS software should calculate the various criteria used to score redistricting plans interactively. In Ohio, the software used in the competition interactively calculated each plan's compactness scores, community fragmentation counts, and showed the number of majority-minority districts. Though it was not done, the Ohio competition also could have interactively calculated the competitiveness for each district.

The next challenge will be interactively calculating the total score of a given redistricting plan. In Ohio, individual measures of a plan could be calculated within the GIS software because they involved computations on data for each district. A plan's total score, however, could not be calculated in the program. Instead, the data from the GIS software had to be exported to a spreadsheet in which final measures for the plan were calculated. Another operation was required to merge all the plans, rank them on each criterion, weight each criterion rank, and sum the weighted ranks in order to determine which plans were judged as better than others.

Other software systems may supply tools without the need for special programming to calculate some metrics for each district,[11] but none the author knows of outputs a set of overall measures such as

10. In one case, the SOS asked CSU to convert a contestant's paper maps of the designed plan to the software system and run all the required functions to produce resulting measures. In communications with the user it was clear that he understood the districting process well but, despite attempts, could not use the software.

11. Maptitude for Redistricting, for example, computes compactness and reports which communities are fragmented. However, it does not provide a count of fragments either as the plan is created or for the final plan. See the reference to the software in note 9.

average or median competitiveness, the number of districts within specified competitiveness ranges, or the number of Republican or Democratic-leaning districts resulting from a plan.

The next generation of districting software and data systems should provide the overall plan's results on such criteria as degree of representational fairness, number of fragmented communities, and number of majority-minority districts. Further, the ideal system would offer the user a choice of standard methods for measuring compactness, competitiveness, and other criteria. Customization of these measures could also be offered to those users wanting to use non-standard or newer methods. These calculations should be provided by a districting software system both as the plan is being created and once the plan is finalized. The integration of these functions and tools will further the use of GIS as a tool to support creative redistricting decisions.

Another step in the right direction of making the process transparent would be the ability to see other plans and compare their results. A clearinghouse for redistricting plans would make alternative proposals publicly accessible. This is technically possible and is receiving attention because of the availability of the Internet.

*Availability via the Internet*

The Internet is important for making the political redistricting process more democratized and transparent. Making alternative proposed plans available over the Internet is a critical step in bringing the redistricting process out into the open.

The Ohio experience was successful in making proprietary vendor software available on the Internet via a terminal server. The cost of the project might have been prohibitive had it required leasing computer labs around the state with the necessary PC-based software to give participants access to the required resources. Districting software specifically designed as a web application should further reduce costs and expand accessibility.

The Internet offers more than just access to the software and data; it can provide easy and affordable access to training and consulting services, as well as enable sharing and discussion of plans. With some GIS redistricting vendors already providing published plans on the Internet, it seems like it would be easy enough to develop a software system that imports alternative plans, enables others to revise them, and then runs comparative analyses based on criteria selected by the user. While some might see such an exchange of ideas and suggestions as potentially disruptive to the decision-making process, this exchange would facilitate transparent selection of a final plan and further discussions about future improvements to the redistricting process.

*Data Improvements*

Finally, the grist with which the redistricting software does its work—the data—should be improved. The data to be used for redistricting in Ohio and other states will be estimated using both GIS and assumptions about the geographic distribution of population and election results within census blocks. The effect of producing data for redistricting that are subject to estimation error may be an important issue, potentially affecting the various criteria used to draw the lines.[12]

There are a number of ways to reduce the potential for data discrepancies. First, because the data needed for redistricting include both population data from the census and recent election results from the local elections offices, it is essential that the Census Bureau and state and local elections officials work together to make the data consistent.

The Census Bureau should improve its Boundary and Annexation ("BAS") program so that its geographic database is more current and is consistent with the boundaries that local elections officials recognize. In Ohio, the boundaries recognized locally are too often not the ones used by the Census Bureau in collecting and reporting

12. How the data are collected and the errors in and the static nature of the census population data could also be important issues, though they are not the focus of this paper. For example, a particularly heated controversy exists over where prison populations are counted. They have been and will continue to be enumerated at the site of the prison, though a recently announced decision notes that the Census Bureau will flag census blocks that include such populations. *See* Press Release, Prison Policy Initiative, Advocates Commend Census Bureau for Enhancing States' Access to Data on Prison Populations in 2010 Census (Feb. 10, 2010), *available at* http://news.prisonpolicy.org/T/ViewEmail/r/6B7E1876801298F9/99E6DC117A52 4C84F6A1C87C670A6B9F. On a practical level, other geographic issues are also potentially important to consider, including errors in the Census Bureau's geographic database. Possibly the most egregious potential for error is in the delineation of municipal boundaries. The experience in Ohio is that county boards of elections sometimes use different municipal boundaries than the ones shown on census maps. This most often happens in areas of annexation that the Census Bureau has not included in its geographic database. The Census Bureau tries to keep current and accurate information through its Boundary and Annexation (BAS) program, in which local officials are asked to report updates to municipal boundaries. If there is a populated area bounded differently on local and Census maps, the problem can either be that the board of elections is assigning voters to the wrong election districts or the Census Bureau is incorrectly reporting the populations of those places.

population data. That may be due to incomplete or poor participation by the local engineers who the Census asks to participate in the BAS program. These local engineers are periodically asked to inform the Bureau about annexation or corrections to local political boundaries. The local boards of elections are not part of that dialogue. As a result, the boundaries recognized by the Census Bureau can be incorrect or out of date, and might not agree with precinct geography. Indeed, the boards of elections may assign some voters to incorrect election districts, and thus causing voters to cast ballots on the wrong candidates and issues. Greater involvement by the local boards of elections in the early build-up to the decennial census would help reduce many of these errors and inconsistencies.

An improved process, including better use of the Internet to collect local boundary data, would improve the data and limit the degree to which population estimation is required once the census data are released. The technology offered by Internet mapping and map editing could eventually make this suggestion for precinct boundary data collection through the Internet a reality.

A second way to improve data for redistricting would be to make neighborhood-level socioeconomic and housing data collected through the American Community Survey ("ACS") more readily available. This data would provide important alternative definitions of communities of interest. For example, redistricting programs that choose to use small-area data (such as census blocks, block groups, and tracts) could provide the geographic specificity needed to carve out either very homogeneous or very heterogeneous districts.

The small-area data that will be released in the fall of 2010 will consist of averages of the five years of data collected in the 2005 through 2009 surveys. Thus they will roughly represent conditions as of 2007. While these estimates of socioeconomic characteristics of the population are not as current as one might like, they would provide valuable information for constructing geographic communities of interest. Slightly more current estimates based on five-year averages from the 2006 through 2010 will be available in the fall of 2011. However, the estimates released in 2010 and 2011 are not planned to include estimates for precincts.[13] For redistricting efforts that rely on precinct-level data, inclusion of the socioeconomic data for precincts

13. E-mail to Mark Salling from Catherine M. McCully, Chief, Census Redistricting Data Office (May 5, 2010) (on file with author).

from the ACS could be used for building districts that preserve communities of interest.

## IV. CONCLUSION

Before GIS can become an effective tool to facilitate public participation in redistricting, the user interface of GIS software needs significant improvement, GIS systems need to be accessible over the web, and alternative and flexibly computed criteria metrics need to be included. In addition, more accurate, current, comprehensive, and integrated data is needed to facilitate the evaluation of redistricting plans that meet various political criteria for fairness. Some of these improvements may be developed and implemented in time for the 2011 redistricting process.

A collaborative project among researchers at George Mason University and the Brennan Center for Justice at New York University, with the assistance of Micah Altman at Harvard University, is developing a free and publicly accessible system named BARD[14] with many or all of these capabilities. However, it is likely that the consultants and staff advising the politicians and decision makers on where the boundaries should be drawn will continue to use commercial proprietary systems. Nevertheless, a resource like BARD would enable others to suggest plans and question the selection of the final ones.

Regardless of the progress made in the next year, we can hope that the eventual adoption of a transparent, public participation redistricting process for all the states, along with solutions to the data issues noted above, will happen in 2021.

14. United States Election Project, http://elections.gmu.edu/Redistricting.html (last visited Apr. 5, 2010)