# Geographic Information Systems and the Political Process

Dr. Cheryl Hanewicz

Utah Valley University

February 28, 2012

Presented at the
Western Political Science Association
2012 Annual Meeting
Portland, Oregon
March 22-24, 2012

## Abstract

A geographic information system (GIS) is a computer-based database system that is used to store, analyze, and manipulate geographically referenced data. Spatial data stored in a GIS are used to draw roads, geographic borders (e.g., state map), and political boundaries as well as pinpoint locations such as cities or house addresses. Attribute fields can be used to add information such as the name of a city or political party of a homeowner, which can be displayed onscreen or printed on a map.

What makes a GIS so powerful is its ability to layer thematic maps vertically, such as a population density map over precinct boundaries, and calculate distances between two or more locations accurately. GIS technology has been used in recent elections to view voter turnout and determine where politicians should focus their efforts. GIS technology also has the ability to give traditional gerrymandering a technological boost by combining demographic (e.g., Census) and geographic data within a single information system. In this paper the author will review the current and potential uses of GIS technology within the political system and the practical and well as ethical outcomes of using this technology.

# GEOGRAPHIC INFORMATION SYSTEMS AND THE POLITICAL PROCESS

New technologies have created a powerful paradigm shift in political campaigning (Spiller & Bergner, 2010). Elected officials are no longer merely pictures on a classroom wall or caricatures on a television screen. The convergence of the Internet, computers, and social media tools have made politics an immediate as well as interactive process. Candidates have an intimacy with their constituents on a large scale that would not have been possible without modern technology. One of the most significant tools is a geographic information system (GIS), which is a sophisticated mapping technology. Politicians can review political hot spots at a glance or determine which neighborhoods to focus their message. The diverse applications of GIS have made its use attractive to people in business, industry, government, and education.

## Geographic Information Systems

A geographic information system is a computer-based database system that is used to store, analyze, and manipulate geographically referenced data. The most common output of a GIS is a map, and the online website, Mapquest, is a familiar example. Spatial data stored in a GIS contain latitude and longitude or x,y coordinates, which are used to draw roads, geographic borders (e.g., state boundaries or voting districts), and pinpoint locations such as fire hydrants, house addresses, or cities. Attribute fields can be used to add information such as the name of a city, which can be displayed onscreen or printed on a map (see Figure 1). Inherent in any GIS application is the capability to enter data through actions such as scanning and digitizing maps, importing existing database information, or entering data directly into the system. What makes a GIS so powerful is its ability to layer thematic maps vertically, such as a population density map over a city map, and calculate distances between two or more locations accurately.

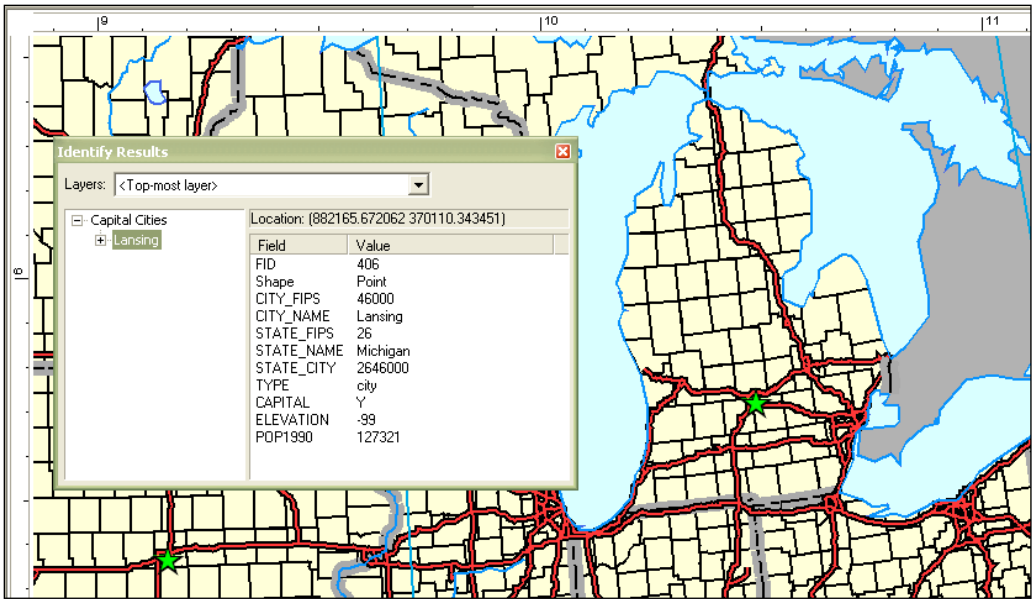


*Figure 1*: Screenshot of ArcMap document.

From ESRI, ArcMap 9.0 (ArcView) software, USACounties template (software).

Geographic information systems have their roots in the geography profession, and their use can be traced back to the mid-1950s (DeMers, 2003). Initially, geographers created maps of natural resources. These activities were funded primarily through government officials, because they had the money to support these costly endeavors. Professionals in other fields began using GIS for their own operations as information technology and processing power expanded while related computing costs decreased (Pick, 2008). According to Tomlinson (2009), "At least 5 million people in more than 300,000 institutions in more than 150 countries are using geographic methods in their work daily" (para. 35).

Leading industries that use GIS systems include utility companies, transportation authorities, real estate corporations, and retail stores. Utility company personnel are able to plan and map power lines or water pipes as well as track the location of their customers (Fritz& Skerfving, 2005; Grimshaw, 2000; Somers, 2004). Transportation authorities track fleets of trucks in real time by integrating global positioning system (GPS) tools with their GIS systems.

"Recently a great deal of convergence has occurred between wireless devices, location technologies, and spatial management and analysis tools with the result that many firms can now manage fleets in real time in a seamless manner" (Hackbarth & Mennecke, 2005, p. 208). These same advances benefit the growing aviation industry. GIS technology can help manage plans to add new airports and runways while increasing safety and efficiency (Kalinski, 2010). Realtors and retailers are other prime GIS users, since their businesses are based primarily on location and the surrounding environment. Using a variety of thematic maps, business analysis software, and lifestyle mapping systems, users can quickly determine new areas for development (ESRI, 2007).

GIS has the capability to track events and trends, which makes it a valuable tool for health care professionals and law enforcement officials. Researchers have used GIS to determine the distribution of illnesses such AIDS (Jenks & Malecki, 2004) and melanoma (Eide, Weinstock, & Clark, 2009). Law enforcement officials use GIS systems similarly to track and analyze crime patterns (Craglia, Haining, & Wiles, 2000; Keeling, 2009). The information provided by GIS allows officials to develop and implement more effective policing policies. In partnership with fire, safety, and emergency personnel, they use GIS to coordinate services, such as those with Homeland Security (Brown, 2005; Hilton, Horan & Tulu, 2005; McKay, 2005).

Governmental employees are among the largest users of GIS (Grimshaw, 2000). Census Bureau employees in many nations, including the United States, Canada, and the United Kingdom, use GIS to map survey data (Harris, Sleight, & Webber, 2005). Information collected from the census surveys, including household income, racial profile, educational attainment, and other sociodemographic characteristics, are aggregated and mapped to a predefined census area that is small enough to include citizens from similar neighborhoods yet large enough to conceal individual identities. Information obtained by United States Census workers is available through

the U.S. Census Bureau at their American FactFinder web site. Information can be downloaded as data files (to upload in a GIS system) or available in a ready-to-use format such as shown in Figure 2.

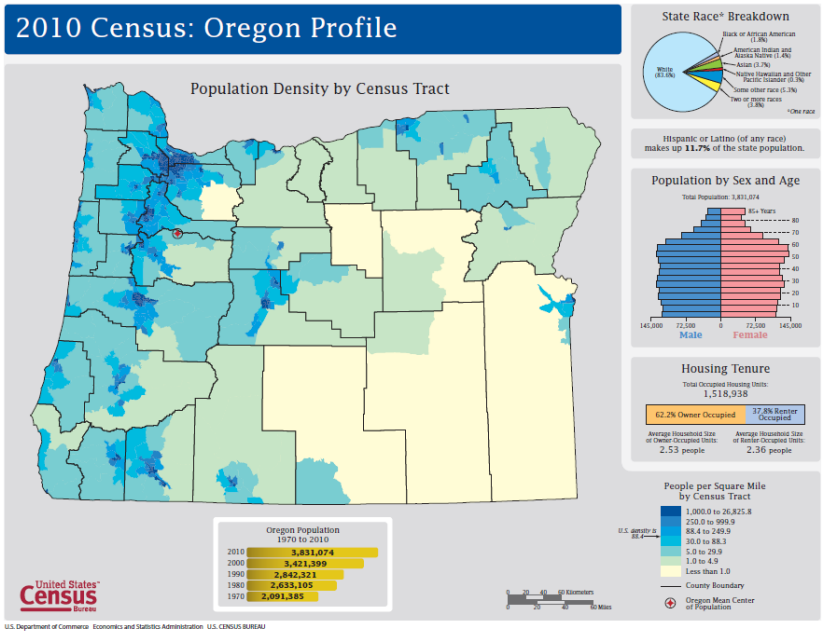


*Figure 2*: 2010 Census: Oregon Profile.

From U.S. Census American FactFinder, retrieved from http://www2.census.gov/geo/maps/dc10_thematic/2010_Profile/2010_Profile_Map_Oregon.pdf

While there has been an increase in GIS use among business and government personnel, its application in higher education has not been as widespread (Sanders, Jr., Kajs, & Crawford, 2001). One of the common uses for GIS is in marketing and enrollment services. Some educational researchers have used student data (i.e., addresses and academic information) to identify geographical areas of student interests in which to market their programs (Buliung & De Luca, 2000; Burke & Minassians, 2001; Tang & McDonald, 2002). Other academic scholars obtained sociodemographic information through private companies and the U.S. Census Bureau

to classify neighborhoods that contained students most likely to succeed at their institutions (Burger, 2004; Herries & Marble, 1997; Marble, Mora, & Granados, 1997) and identified patterns of student retention in higher education (Hanewicz, 2009). However, administrators of GIS need to be vigilant in their use of sociodemographic data to target particular groups of people, or they may be culpable of social profiling.

## GIS and Redistricting

Redistricting is a constitutional mandate. Every ten years all local, state, and federal government officials must use decennial census data to redraw their election districts. The purpose of redistricting is to maintain appropriate representation that reflects changes in the population. Many regulations have been enacted to protect the "one person, one vote" edict, since this process can be a politically sensitive activity. Redistricting can impact significantly the fate of incumbents, political parties, interest groups, school districts, and citizens. Distribution of public funds is also a salient concern. Nunnari and Ueda (2010) found that counties that were divided into more congressional districts through redistricting received less federal funding.

Historically, redistricting was based on hand-drawn maps often produced in private, smoke-filled rooms. It was an arduous process, required numerous man hours, and may or may not have resulted in equitable outcomes. "The resulting districts often split cohesive communities and produce legislatures that neither meaningfully represent constituents, nor reflect the diversity and views of the public" (Levitt, 2010, p. 6). Prejudicial redistricting can be the consequence of ineffective workers or gerrymandering. Gerrymandering is the intentional manipulation of a voting district's geographic boundaries to give a political advantage to a person, party, or community of interest. Regardless of the cause, inequitable redistricting has the potential to

interfere with the voting rights of citizens. Hayes and McKee (2009) found that voter participation was lower in House elections in districts that were redrawn.

One challenge to altering the redistricting process is that each state has its own rules. The only national requirements are that decennial census data must be used and the redistricting must be done within a year. A large majority of states draw House districts in the legislature, and seven states use a commission to define them (Meyertholen, 2011). The Brennan Center for Justice has identified two practices that would make any redistricting process more transparent to citizens and responsive to community needs. The first is that the process should be open to the public, and the second is that it should be held accountable to citizens (Levitt, 2010).

Redistricting is a geographic problem; GIS is a geographic solution. Mapping technology has been used in the redistricting process since the 1980s. Its use expanded in the 1990s when high-level users had the capacity to create approximately 100 scenarios for about $80,000-$100,000. By 2000, 1,000 or more scenarios could be developed for $20,000. Today, powerful computers are affordable to the average user, and thousands of solutions cost only $4,000-$6,000 to produce (Meyertholen, 2010). According to Richard Leadbeater, ESRI State Government Industry Manager, "The expectations are there that citizens want to be involved. The Internet has opened up an entire new audience for redistricting. They're going to want to be involved. They're going to have the tools at their disposal. So redistricting now has a consumer-level expectation" (Meyertholen, 2010).

GIS technologies have already been used successfully to share information with citizens and receive feedback from them as well. In Maricopa County, Arizona, citizens can use interactive mapping technology on the web site to review proposed redistricting maps and develop their own proposals with a click of a mouse. The web site also allows people to attend

public redistricting hearings online (Meyertholen, 2012). The Texas Legislative Council created a similar resource for its citizens. Users can access legal requirements, view maps and reports, and download data for their own use (Texas Legislative Council, n.d.).

It is important to note that GIS is not the magic bullet that will end political conflict over redistricting or stop accusations of gerrymandering. Redistricting is not just a numbers game. It is a complex process that needs to balance legal criteria, communities of interest, and geographical boundaries (Meyertholen, 2011). GIS can be used to create election districts that allow minority groups local majorities or dilute their ability to elect favorite candidates. "Either strategy can be characterized as gerrymandering, because each favors one set of political principles over others" (Forest, 2005, p. 15333).

## Using GIS to Connect with Constituents

The power of a geographic information system is that it is not just a one-dimensional technology. Thematic layers can be used to create a multidimensional view of a geographic area over time. This type of mapping can show changes in population density, fluctuations in air quality, or evolving political-party affiliation. Consequently, administrators throughout the political system have found innovative ways in which to use the spatial and organizational capabilities of a GIS.

### *GIS and Voting*

Registering new voters can be a time-intensive process. There are several established programs designed to get citizens registered to vote, including Declare Yourself, Rock the Vote, Smackdown Your Vote, and Voto Latino. It is apparent by the names that these groups are targeting specific individuals such as young people and Latinos. This is an area where GIS can be useful, since users can obtain voter registration, age, and other demographic information.

> Local governments are recognizing the importance of voter outreach programs but, more importantly, they are realizing the integral role that technology can play in locating underrepresented communities with low voter registration. They understand that GIS can make get-out-the-vote drives smarter, faster, and more cost-efficient. (Peters, DeYoung, and Ross, 2004, p. 1)

The voting process can be more effective using GIS technology. Maricopa County, Arizona, Recorder, Helen Purcell, is using 2010 Census data to combine precincts and better manage the polling process. Precincts that contain large numbers of people who vote by mail can be joined with others yet not impede the rights of those who vote in person. She predicts that this increase in efficiency will save the county $1,000,000 during 2012. These savings will come from needing fewer workers, fewer trainers and training establishments, as well as fewer trucks needed to deliver equipment (Meyertholen, 2012).

Starting in January 2012, NBCPolitics.com added an interactive candidate check-in map, so users can follow President Obama's and the Republican presidential candidates' campaign teams in real-time. This map lets citizens be more engaged with their candidate on the campaign trail as well as allow politicians to communicate with voters. "Central to this experience is an interactive map that is designed to reveal a narrative about the 2012 election" (Partyka, 2011, para. 8).

*GIS and Political Policies*

Politicians can use Census data to determine how their actions will affect their electorates. If they are developing or debating a new piece of legislation, they can use GIS tools to run possible scenarios to get answers to the following potential questions: Who will the new policy affect? Who will pay the taxes? Where do they live? Is it in my district? How will it affect the people who vote for me? (Meyertholen, November 2010). Sui and Hugill (2002) geocoded addresses to precinct maps to determine which registered voters cast their ballots in several local

elections in College Station, Texas, and which registered voters did not. When this type of information is displayed on a map and cross-referenced with election issues, it is easy to see where patterns or clusters emerge and help decipher what issues matter to people locally.

Political campaigners have often been on the forefront of using new technologies, including phone surveys, television ads, and online donations. GIS can be used to connect with voters in more sophisticated ways. "With this software, computer analysts can literally take dozens of pages of complex information and make a single, multicolored map that shows factors such as household density, family size, or racial and socioeconomic composition of neighborhoods along with their implied political and social attitudes where available from public opinion data" (Novotny & Jacobs, 1997, p. 269). It is also easy to locate and track party members, since they are a good source of income and support. A GIS map can help national parties get a broad overview of the "red" versus "blue" states as shown in Figure 3. Forest (2005) believes that political parties have received the most benefit from GIS technology, because it gives them further control over elections by creating precise gerrymanders (p. 15334).

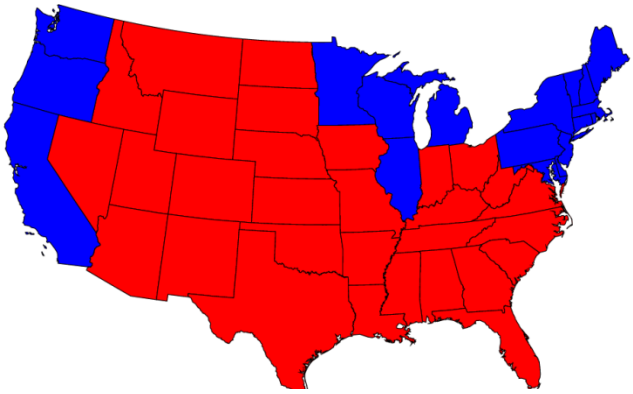

Figure 3: 2004 Presidential Election by States. Retrieved from http://www.cscs.umich.edu/~crshalizi/election/

Administrative groups at all levels can use GIS tools to pursue a partisan goal. Higher education personnel, who depend on public funding to sustain their institutions, have used GIS to reach their constituents. Analysts at Binghamton University (SUNY) in the State of New York created a GIS to analyze fundraising patterns of alumni and target areas that likely contained a

large number of potential donors (Jardine, 2003). Using a database that contained more than 75,000 alumni records, distribution maps were created to show concentrations of students and donation amounts by state and New York counties. An additional map was used to display the numbers of alumni and students living in districts of congressmen and congresswomen who serve on appropriations committees. "These committees appropriate research dollars at the federal level. GIS can be used to illustrate the magnitude of the presence of alumni and students in these key districts" (Jardine, 2003, p. 77).

Similarly, University of Florida (UF) administrators faced a seriously eroding financial base and wanted to increase political support for their institution as a means of obtaining more funding. UF is a residential campus and students come from all geographical areas of the state. Knowing the names of students' state legislative representatives/senators could help when lobbying efforts needed to be undertaken. Thrall and Mecoli (2003) geocoded permanent addresses to enumerate them by Florida State House of Representatives' districts. These student records were inserted into a University database so personnel could easily contact constituents about legislative events and garner political support. Voter registration data were also obtained, in part, to determine political party affiliation. According to Mecoli (2004), voter information can be used to inform administrators about students' potential support for various educational measures or to indicate which students should be encouraged to vote on specific issues.

Personnel in many organizations have shown the utility of using GIS-based systems for their unique needs. Governmental concerns at different levels have varied; yet users have operationalized similar GIS tools to address diverse issues, such as finding the best place for a polling station or calculating the potential political cost of passing a new law. With a GIS, Census data, election records, and other sociodemographic statistics, users have immeasurable

knowledge at their fingertips. According to Kim Brace, president of Election Data Services, "It's really a gold mine of information . . . for anybody in the legislative process" (Meyertholen, December 2010).

## Ethical Considerations of Using Information Systems

GIS falls under the umbrella term "information technology" (IT), which "is any computer-based tool that people use to work with information and support the information and information-processing needs of an organization" (Haag, Cummings, & Phillips, 2007, p. 4). Because marketers, governmental employees, and researchers use IT systems to store and analyze large amounts of data, there is concern about the morality of their use, especially in regard to personal privacy (Beekman, 2003; Cassidy, Chae, & Courtney, 2005; De George, 2003; Deshmukh & Croasdell, 2005; Freeman, 2005; Haag et al. 2007; Hartzel & Deegan, 2005; Reynolds, 2007). "The development of computer technology has made possible the accumulation and correlation of vast amounts of data on each individual, which in turn has affected both the general public's (and business's) view of privacy, and the issues of protection of personal information" (De George, 2003, p. 40).

No general legal definition of privacy exists; nor is it explicitly addressed in the Constitution of the United States (Beekman, 2003; De George, 2003). Instead, ideas about what constitute privacy are often enmeshed in cultural traditions and expectations (De George, 2003). "The right to privacy is a fundamental, constitutive norm of American democracy. . . . People want and expect a certain right to privacy, even to an extent that is sometimes greater than what the law guarantees" (Freeman, 2005, p. 165). Many legal scholars have agreed that privacy rights are implicitly defined in citizens' constitutional rights; but without an explicit guarantee, interpretations remain open to debate (Beekman, 2003; De George, 2003).

Americans do have legal rights concerning aspects of their private life, including marital relationships (De George, 2003) and medical history (Deshmukh & Croasdell, 2005). Laws such as the Electronic Communication Privacy Act of 1986, the Privacy Act of 1974, and the PATRIOT Act of 2001 contain specific rules regarding how some personal data (e.g., motor vehicle and credit information) can be disclosed to third parties (Freeman, 2005). However, Beekman (2003) argued that many federal and state laws involving privacy rights were written before the widespread use of information technology.

People disclose information about themselves in many ways, such as completing an application or using a credit card. If consumer information was stored and used only by the business personnel who gathered it, the debate surrounding its use would not be so contentious. However, the ease with which vastly connected computer-network systems can exchange data exponentially multiplies the risk. "As long as the files share a single unique field, such as a Social Security number field, record matching is trivial and quick. And when database information is combined, the whole is often far greater than the sum of its parts" (Beekman, 2003, p. 231). The sheer number of companies that compile and disseminate such information is cause for concern. According to Beekman (2003), over 15,000 marketing databases containing personal information (e.g., address, income, and political affiliation) on 2 billion consumers exist. Demographic information can also be obtained for free from the U.S. Census Bureau; then these data can easily be incorporated into GIS (Peters & MacDonald, 2004).

Cassidy et al. (2005) recognized several advantages to utilizing consumer information. For instance, retailers can determine customers' buying patterns and stock merchandise that is most likely to be purchased. Businesspeople can also create specialized marketing campaigns to target customers based on their individual preferences. "The application of GIS to retail point-of-

sale data holds great promise in allowing retailers to gain greater insights into consumer spatial behavior" (Allaway, Murphy, & Berkowitz, 2005, p. 261).

Geographic information systems are a specialized category of IT that can be used to represent information graphically (i.e., maps) and target neighborhoods as well as individuals. "Prior to the advent of geographic information systems (GIS), spatial data was [*sic*] difficult to use, expensive to collect, and often of uncertain quality" (Allaway et al., 2005, p. 261). The availability of sociodemographic and geographic data, along with the ability to download topographical maps are changing the political landscape. In fact, the term "geodemographics" has been added to the English-language lexicon to refer to the ability of demographers to accurately predict consumer behavior based on neighborhood characteristics (Harris et al., 2005). "The fact that various socio-economic forces can 'filter' people to live in certain 'types' of neighbourhood is the basis for how neighbourhood analysis predicts the likely population characteristics to be found in any given area" (Harris et al., p. 15). Traditional IT systems have been used to store and disseminate demographic and socioeconomic information about a particular person; GIS, with their mapping functions, can target individuals who live in a neighborhood based on presumed shared preferences. "These behaviors can be measured, predicted, and targeted" (ESRI, 2011).

Geodemographers can now include data from numerous databases to create neighborhood profiles; information that may be incorporated in these profiles includes census-bureau data, crime statistics, credit reports, health of citizens, political affiliation, voting history and types of housing (Harris et al., 2005; Meyertholen, December 2010). Consequently, businesses have been created to sell such lifestyle data. Claritas, Inc., one of the leading geodemographic companies, has been in business for more than 30 years (Claritas, Inc., n.d.). A brochure produced by

Claritas, Inc., (2008) contained 66 demographic types, including creative names such as Gray Power (aging, middle-class suburbanites), Young Digerati (young, tech-savvy people living in trendy neighborhoods), and Kids & Cul-de-sacs (upscale families who read parenting magazines). Tapestry Segmentation is a similar lifestyle-data product produced by ESRI (ESRI, 2011), one of the leading GIS companies. In the 1980s political candidates began to understand how these technologies could take the guesswork out of finding desirable voters; those who could afford them began to use them (Novotny & Jacobs, 1997).

## Conclusion

GIS technology is an established part of the political landscape. As such, it can be both headache and aspirin in 21st Century politics. Candidates can customize their lobbying efforts by neighborhood or see how a new law might affect the citizens in a district. However, they should also be cautioned against using lifestyle data arbitrarily. To assume homogeneity falsely among people in a manually defined geographic area is known as the ecological fallacy (Harris et al., 2005). Birds of a feather do not always flock together. Voters may resent being categorized indiscriminately or having their personal information collected, used, and disseminated without their consent.

Redistricting has become a more transparent process in many states, since residents can view prospective maps on interactive web sites and voice their opinions. Some districts even allow them to submit their own ideas for consideration. These are important ways to educate and engage citizens. However, GIS technologies can be used by skilled legislators to create nuanced gerrymanders that impede a populace's voting rights.

> Sophisticated analytic techniques and GIS technology allow us to understand and predict electoral outcomes and effects with increasing precision. Although they hold out the possibility of a more 'representative' electoral system, these tools cannot create a consensus on what 'representative' should mean (Forest, 2005, 15336).

How do we assure that we don't lose the power of our vote, a central principle of democracy, or our individuality, a core cultural belief, to the growing impact of technology? The most important maxim to remember is that any technology is simply a tool. It is the responsibility of officials to use data conscientiously and not forget that behind every fact and figure is a real person. It is the responsibility of citizens to educate themselves about the political process and their rights and civic duties. Dialog, education and balloting are the primary means to assuring that Democracy is more than an abstract political theory.

References

Allaway, A. W., Murphy, L. D., & Berkowitz, D. K. (2005). The geographical edge: Spatial analysis of retail loyalty program adoption. In J. B. Pick (Ed.), *Geographic information systems in business* (pp. 260-277). Hershey, PA: Idea Group Publishing.

Beekman, G. (2003). *Computer confluence: Exploring tomorrow's technology (5th ed.)*. Upper Saddle River, NJ: Prentice-Hall, Inc.

Brown, J. (2005). To the rescue. *Government Technology*, 18(2), 44-46.

Buliung, R. N., & De Luca, P. F. (2000). Spatial patterns of demand for education: A case study [Electronic version]. *Journal of Geographic Information and Decision Analysis, 4*(2), 37-51. Retrieved June 29, 2005, from http://www.geodec.org/Buliung.pdf

Burger, P. R. (2004). Market-area analysis - not just for business anymore. *Geospatial Solutions, 14*(5). Retrieved July 2, 2005, from http://www.geospatial-online.com/geospatialsolutions/article/articleDetail.jsp?id=93556

Burke, J. C., & Minassians, H. (2001). *Linking state resources to campus results: From fad to trend*. Retrieved November 3, 2005, from The Rockefeller Institute of Government: http://rockinst.org/publications/higher_ed/5thSurvey.pdf

Cassidy, C. M., Chae, B., & Courtney J. F. (2005). Ethical management of consumer information: Solving the problem of information externality using the Coasian approach. In L. Freeman & A. G. Peace (Eds.), *Information ethics: Privacy and intellectual property* (pp. 120-142). Hershey, PA: Information Science Publishing (an imprint of Idea Group Inc.).

Coleman, K. J., & Fischer, E. A. (2011, January 13). *The help America vote act and elections reform: Overview and issues*. Congressional Research Service, 7-5700.

Claritas, Inc. (2008). *Claritas PRIZM [Brochure]*. Retrieved on February 20, 2012, from http://ocair.org/files/KnowledgeBase/HowTo/PRIZM_Code.pdf

Craglia, M., Haining, R., & Wiles, P. (2000). A comparative evaluation of approaches to urban crime pattern analysis [Electronic version]. *Urban Studies, 37*(4). Retrieved July 2, 2005, from Info Trac OneFile Plus.

DeMers, M. N. (2003). *Fundamentals of geographic information systems (2nd ed.)*. Hoboken, NJ: John Wiley & Sons, Inc.

De George, R. T. (2003). *The ethics of information technology and business*. Malden, MA: Blackwell Publishing Ltd.

Deshmukh, P., & Croasdell, D. (2005). HIPPA: Privacy and security in health care networks. In L. Freeman & A. G. Peace (Eds.), *Information ethics: Privacy and intellectual property* (pp. 219-237). Hershey, PA: Information Science Publishing (an imprint of Idea Group Inc.).

Eide, M. J., Weinstock, M. A, & Clark, M.S., *Demographic and socioeconomic predictors of melanoma prognosis in the United States*. Journal of Health Care for the Poor and Underserved 20 (2009): 227–245.

ESRI. (n.d.). ArcGIS Desktop Help, Z-score Rendering [Spatial Statistics]

ESRI. (2007, February). GIS best practices. Retrieved on February 24, 2012, from http://www.esri.com/library/bestpractices/real-estate.pdf

ESRI. (2007, Winter). *The geographic distribution of graduates*. GIS Educator.

ESRI (2009, Fall). GIS for renewable energy. *Arcnews Online*, Retrieved on February 4, 2010, from http://www.esri.com/news/arcnews/fall09articles/gis-for-renewable.html

ESRI (2011). Tapestry segmentation. Retrieved on February 13, 2012, from http://www.esri.com/library/brochures/pdfs/tapestry-segmentation.pdf

Forest, B. (2005, October 25). The changing demographic, legal, and technological contexts of political representation. *Proceedings of the National Association of Science*, *102*(43), 15331-15336.

Freeman, M. (2005). Counterterrorism and privacy: The changing landscape of surveillance and civil liberties. In L. Freeman & A. G. Peace (Eds.), *Information ethics: Privacy and intellectual property* (pp. 163-179). Hershey, PA: Information Science Publishing (an imprint of Idea Group Inc.).

Fritz, O., & Skerfving, P. (2005). Monitoring and analysis of power line failures: An examples of the role of GIS. In J. B. Pick (Ed.), *Geographic information systems in business* (pp. 301-323). Hershey, PA: Idea Group Publishing.

Grimshaw, D. J. (2000). *Bringing geographical information systems into business.* New York: John Wiley & Sons, Inc.

Haag, S., Cummings, M., & Phillips, A. (2007). *Management information systems for the information age (6th ed.).* New York: McGraw-Hill/Irwin.

Hackbarth, G., & Mennecke, B. (2005). Strategic positioning of location applications for geo-business. In J. B. Pick (Ed.), *Geographic information systems in business* (pp. 198-210). Hershey, PA: Idea Group Publishing.

Hanewicz, C. (2009). *Identifying student retention patterns using GIS technology*. Portland International Center for Management of Engineering and Technology, 2009 Proceedings, August 2-6 Portland, OR.

Harris, R., Sleight, P., & Webber, R. (2005). *Geodemographics, GIS and neighbourhood targeting.* Chichester, West Sussex, England: John Wiley & Sons, Ltd.

Hartzel, K. S., & Deegan, P. E. (2005). Balancing individual privacy rights and intelligence needs: Procedural-based vs. distributive-based justice perspectives on the PATRIOT Act. In L. Freeman & A. G. Peace (Eds.), *Information ethics: Privacy and intellectual property* (pp. 180-195). Hershey, PA: Information Science Publishing (an imprint of Idea Group Inc.).

Hayes, D., & McKee, S. C. (October, 2009). The participatory effects of redistricting. *American Journal of Political Science, 43*(4), 1006-1023.

Herries, J., & Marble, D. (1997). *A model for the use of GIS technology in college and university admissions planning.* In *Geodemographic analysis and GIS technology in college and university admissions planning.* 1997 ESRI User Conference. Retrieved January 19, 2005, from ESRI Web site http://gis.esri.com/library/userconf/proc97/proc97/to250/pap218/p218.htm

Hilton, B. N., Horan, T. A., & Tulu, B. (2005). Geographic information systems in health care services. In J.B. Pick (Ed.), *Geographic information systems in business* (pp. 212-235). Hershey, PA: Idea Group Publishing.

Jardine, D. D. (2003, Winter). Using GIS in alumni giving and institutional advancement. In D. Teodorescu (Ed.) & J. F. Volkwein (Ed.-in-chief), *Using Geographic Information Systems in Institutional Research, (*120, pp. 77-90). New Directions for Institutional Research series. San Francisco: Jossey-Bass.

Jenks, R. H., & Malecki, J. M. (2004). GIS - A proven tool for public health analysis. *Journal of Environmental Health, 67*(3), 32-34. Retrieved July 1, 2005, from InfoTrac OneFile via Thomson Gale http://find.galegroup.com.ezproxy.emich.edu/itx/infomark.do?&contentSet=IAC-Documents&type=retrieve&tabID=T002&prodId=ITOF&docId=A123241098&source=gale&userGroupName=lom_emichu&version=1.0

Kalinski, A. (2010, May 10). NextGen, airport bottlenecks hot topics at AAAE GIS conference. *Geospatial Solutions*, GeoIntelligence, retrieved on February 25, 2012, from http://www.gpsworld.com/gis/geointelligence/nextgen-airport-bottlenecks-hot-topics-aaae-gis-conference-9918

Keeling, M. (Summer 2009). ArcGIC server-based tool mitigates graffiti. *ArcUser*, p 16-17.

Levitt, J. (2010). *A citizen's guide to redistricting*. Brennan Center for Justice at New York University School of Law. Retrieved February 10, 2010, from http://www.policyarchive.org/handle/10207/bitstreams/96358.pdf

Marble, D., Mora, V., & Granados, M. (1997). *Applying GIS technology and geodemographics to college and university admissions planning: Some results from the Ohio state university.* Presented at the 1997 ESRI User Conference.

McKay, J. (2005a, September). Funding collaboration. *Government Technology*, 17(9), 32-36, 52.

Mecoli, N. A. (2004). *Using geographic decision information systems to support political endeavors at the university of Florida.* Unpublished master's thesis, University of Florida.

Meyertholen, E. (Writer). (2010, November 30). Redistricting: A geographic problem. *ESRI Speaker Series*. [Audio podcast] Retrieved from http://www.esri.com/news/podcasts/podcast.html#staff_leadbeater

Meyertholen, E. (Writer). (2010, December 3). Laying the groundwork for redistricting. *ESRI Speaker Series*. [Audio podcast] Retrieved from http://www.esri.com/news/podcasts/podcast.html#user_brace

Meyertholen, E. (Writer). (2011, January 7). Deciphering the latest redistricting trends. *ESRI Speaker Series*. [Audio podcast] Retrieved from http://www.esri.com/news/podcasts/podcast.html#user_storey

Meyertholen, E. (Writer). (2012, February 1). GIS for elections and redistricting in Maricopa County. *ESRI Speaker Series*. [Audio podcast] Retrieved from http://www.esri.com/news/podcasts/podcast.html#user_purcell

Novotny, P., & Jacobs, R. H. (1997). Geographical information systems and the new landscape of political technologies. *Social Science Computer Review, 15*(3), 264-285

Nunnari, S., & Ueda, M. (2010, February). The effects of redistricting on distributive outcomes. Retrieved on February 10, 2012, from http://www.hss.caltech.edu/~snunnari/redistricting.pdf

Partyka, J. (2011, December 19). NBC using foursquare for election coverage. *GPS World.* Retrieved on February 24, 2012, from http://www.gpsworld.com/Wireless/Personal%20Tracking/news/nbc-using-foursquare-election-coverage-12442

Peters, A., DeYoung, T., & Ross, E. (2004, October 1). GIS for Get-out-the-Vote campaigns. *Geospatial Solutions Magazine*.

Pick, J. B. (2008). *Geo-business GIS in the digital organization*. Hoboken, NJ: John Wiley & Sons, Inc.

Reynolds, G. (2007). *Ethics in information technology (2nd ed.).* Boston: Thompson Course Technology.

Sanders, Jr., R. L., Kajs, L. T., & Crawford, C. M. (2001). Electronic mapping in education: The use of geographic information systems [Electronic version]. *Journal of Research on Technology, 34.*

Somers, R. (2004). Southern company builds an enterprise GIS framework. *Geospatial Solutions, 14*(4). Retrieved July 2, 2005, from http://www.geospatial-online.com/geospatialsolutions/article/articleDetail.jsp?id=89948

Spiller, L. D., & Bergner, J. (2010). American elections and the competition to govern. *Competition Forum, 8*(2), 306+. Retrieved February 2, 2012, from Questia.

Sui, D. Z., & Hugill, P. J. (2002). A GIS-based spatial analysis on neighborhood effects and voter turnout: a case study in College Station, Texas. *Political Geography, 21*(2), 159-173.

Tang, H., & McDonald, S. (2002, July 9-12, 2002). *Integrating GIS and spatial data mining technique for target marketing of university courses.* In *Symposium on Geospatial Theory, Processing and Applications.* ISPRS Technical Commission IV Symposium 2002, Canadian Institute of Geomatics and ISPRS Commission IV, Ottawa, Canada. Retrieved on July 1, 2005, from http://www.isprs.org/commission4/proceedings02/pdfpapers/553.pdf

Texas Legislative Council (n.d.). *Texas redistricting*. Retrieved on February 26, 2012, from http://www.tlc.state.tx.us/redist/maps_online.html

Thrall, G. I., & Mecoli, N. (2003, July 1). Spatial analysis, political support, and higher education funding [Electronic version]. *Geospatial Solutions.* Retrieved February 17, 2005, from http://www.geospatial-online.com/geospatialsolutions/article/articleDetail.jsp?id=61493

Tomlinson, R. F. (Spring 2009) Changing the face of geography: GIS and he IGU. *ArcNews Online*, retrieved on March 19, 2010, from http://www.esri.com/news/arcnews/spring09articles/changing-the-face.html