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School boundary planning improved by GIS technology

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SCHOOL BOUNDARY PLANNING IMPROVED BY GIS TECHNOLOGY

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ABSTRACT

GIS IMPROVING SCHOOL DISTRICT BOUNDARY PLANNING

By Cindy L. Ross

This thesis addresses the topic of how school districts are benefiting from the use of GIS technology for boundary planning. It examines how school districts are now turning toward the use of GIS as a tool for solving district planning issues and making better-informed decisions within a more suitable time frame while also improving the accuracy of such decisions.

Research will show that school districts have been purchasing GIS software to replace planning techniques that were very time intensive and not very accurate. GIS boundary planning software makes data manipulation easier and quicker, giving the decision makers more options to analyze.

ACKNOWLEDGEMENTS

Five years of professional and personal experience have helped to make this paper possible. Thank you to my colleagues and clients for their insight and for the opportunity to work with school districts implementing new GIS systems. Thanks to Davis Demographics & Planning, Education Logistics, Planware Systems, and the Harrisburg School District for the use of copyright material. Special thanks to Debbie Bicknell of Planware Systems and Joseph Cowan of the Harrisburg School District for their contributions in regards to the questionnaires they willingly completed (see the appendix for more information).

Personal thanks to Debra Szasz for her persistence and encouragement, as well as her industrious editing skills. Lastly, I would like to thank my mother and father for their love and support throughout my educational and personal pursuits.

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INTRODUCTION

GIS or Geographic Information Systems are changing the way spatial information is handled in disciplines such as epidemiology, anthropology, forestry, and business (Clarke 1997, 3). Education has joined the list of those disciplines taking advantage of the benefits of GIS technology. Teachers and students have been using GIS in the classroom, but GIS can also be used to help administrators find new ways to accomplish old and tedious tasks (Fonseca 2000). School district administrations are now purchasing and developing GIS systems to improve the school boundary planning process.

Deciding where school boundary lines should be placed, for most school districts, is not an easy task. There are many variables and factors to be considered when deciding where boundary lines should be drawn. Boundary planning is a collaboration of efforts between different factions whose agendas and goals are not always the same. Good communication and the availability of proper planning tools are needed in order for the boundary planning process to be successful. The school district, the school board, and the community, are examples of entities that could participate in the process. School politics and community pressure will sometimes dictate which groups will be involved in the decision making process.

For many years, school districts have accomplished boundary planning without the use of GIS. Some school districts have used pins or dots to plot the locations of students on paper maps of their district (Bicknell 2003). The distribution of students

(pins) on a map provides the basis for boundary analysis. School districts without the resources to produce or obtain maps sometimes create boundary plans based on student lists and street directory reports. These techniques can be very time intensive and not very accurate. Boundary planning projects that are monumental in scope and complexity cannot be properly planned using these types of methods.

School districts are now using GIS software, utilizing electronic map layers and digital data to improve accuracy, increase efficiency, and enhance interaction and communication among decision makers, so that better-informed decisions can be made. GIS helps to organize data and understand spatial relationships, providing a basis for making more sensitive and intelligent decisions (Environmental Systems Research Institute 1995, i). School districts can also use GIS tools to keep the community informed about the boundary planning process and existing school district configurations. Changes and improvements in GIS technology have given many disciplines including education, the opportunity to realize the advantages of such a powerful analytical tool.

What is GIS?

GIS is a set of tools for analyzing spatial data (Clarke 1997, 3). GIS is a combination of computer hardware and software used to store, reference, manipulate, analyze, query, and display spatial data (see the glossary for technical definitions). GIS is used to display information about places, so that patterns can help to answer questions. "GIS has been referred to as smart mapping because users can identify feature attributes on a map just by a click of a mouse" (Cropper 2003). The power of GIS is only hindered

by lack of data, lack of knowledge, and a lack of imagination. Environmental Systems Research Institute (ESRI), a world leader in GIS, has this to say about GIS in education:

> As a tool, GIS by itself does not provide answers. What it provides to users is the opportunity to exercise creative vision, to integrate information, and to evaluate endless alternatives. Its value is enhanced when the user collaborates with others, and the technology itself facilitates such sharing of resources, understandings, and interpretations (Environmental Systems Research Institute 1998, 3).

History of GIS

The groundwork for GIS was established many years ago. For hundreds of years, cartographers have used maps to describe and analyze spatial features. In 1950, the ability to overlay thematic map layers was invented by Jacqueline Tyrwhitt and in 1959 Waldo Tobler created a model for applying the computer to cartography (Clarke 1997, 7-8). Though rudimentary at first, digital map layers could be created and superimposed for analysis (Figure 1). GIS systems came into being when the analytical possibilities of overlaying digital map layers became evident and the availability of digital map data grew. The U.S. Census Bureau developed the Dual Independent Map Encoding system (DIME) to integrate census data and computer maps to assist in planning the census. In doing so, they realized that patterns and distributions could be analyzed with this new system, as well. One of the first GIS systems developed was the Canada Geographical Information System in 1964 (Gourad 1999, 7). In the late 1960s, other systems were developed and a new data structure created. The Laboratory for Computer Graphics and Spatial Analysis at Harvard University created the *arc/node* or *vector* data structure,

where arcs with nodes at either end could be connected to form polygons (Clarke 1997, 9). This new development became the basis for many GIS packages in use today.

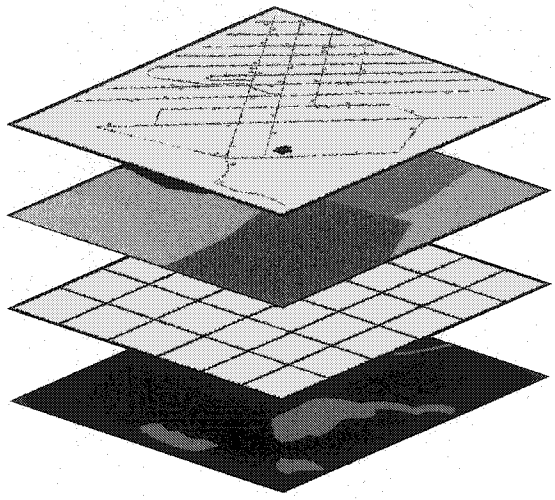

Figure 1. Superimposing digital map layers

GIS has Changed

Over the years, the applications of Geographic Information Systems have changed. Today, GIS is not just for geographers, scientists, and academics. The use of GIS technology is now widespread throughout many disciplines. Geospatial tools are being used for more immediate, practical purposes (Blackwell and Henderson 2000). The use of GIS has spread because declining computer hardware costs have made GIS more affordable to a much wider audience (Environmental Systems Research Institute 1995, 1-1). With the transition of GIS from mainframe to personal computer and with the

potential of a very large user market, desktop GIS software is now being created with tools that are easier to use.

School Districts Consider GIS

The need for better boundary planning tools appears to be evident with over 14,500 school districts in the nation during the 2001-02 school year (Hoffman 2003), many growing at phenomenal rates. In the past, many school districts did not know that GIS existed or that it could be of great benefit for school district planning. School districts are now becoming aware of GIS software for boundary planning. Trade shows, conferences, and aggressive marketing techniques, like magazine advertisements (Figure 2), are helping to spread the word.

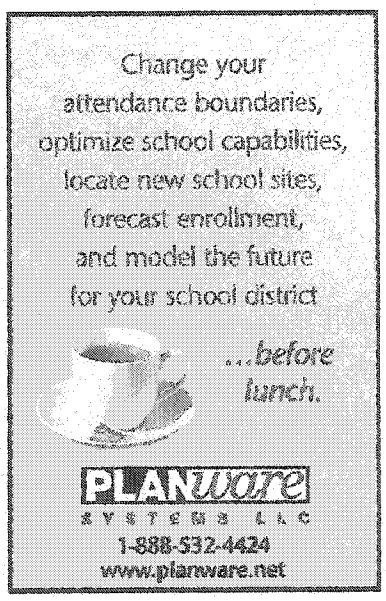

Figure 2. Magazine advertisement as seen in the CASBO Journal. Reprinted, by permission of Jamie Panian, ©Planware Systems, LLC.

Those school districts that did know about the benefits of GIS could not consider it because the cost of purchasing the software and necessary hardware was not justified. Now that GIS systems can be run from desktop computers, hardware costs are not as much of an issue. For many school districts, the benefits derived from the purchase of boundary planning software far outweigh the initial purchase price (Bicknell 2003).

Finding the right staff to prepare and use the system was a problem. GIS software was not designed with simplified user interfaces for people with minimal computer mapping skills. Now that GIS software has become more intuitive, staffing issues are not as much of a problem.

Finding data, like good maps and student information, to build the system was not possible for some school districts. Many school districts now use computerized student information systems to record information on students in their districts. Today, obtaining good student data is easier. Better quality, computer generated maps of school district boundaries can now be obtained and used for digitizing or scanning into the system. Some districts can even request maps and digital map files of their school district boundaries from city and county GIS offices. Depending on the system, digital map layers obtained from other sources can be converted or imported into the GIS system.

CHAPTER 2

BOUNDARY PLANNING

What is Boundary Planning?

Boundary planning involves changing the designation of groups of streets to schools, thereby determining where students will attend school. Usually each school in the district will have a geographic area assigned to it. Typically, students living on streets inside the designated area will attend the associated school (Oxnard Union High School District 1994). This area is sometimes referred to as the *school attendance area* (Figure 3).

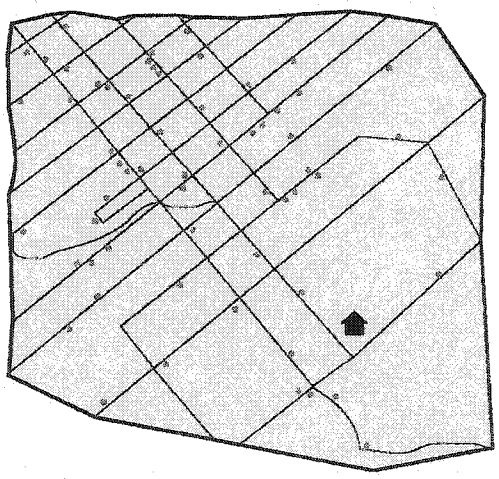

Figure 3. A school attendance area with students and streets

When the district is divided into geographic regions, planners are able to calculate how many students live in certain areas. This gives them the ability to analyze the aggregated characteristics of those students. For instance, planners might be able to count

how many Kindergarten through sixth graders there are in certain neighborhoods and determine if a new elementary school is needed in that area.

Criteria set by the school district and the community will play an important role in choices made during the boundary planning process. The school district decides which factors they wish to acknowledge based on the questions they want answered and from the concerns expressed by other parties involved in the decision making process.

Factors to Consider

School district planning can be a very complicated process with many factors ultimately determining where boundary lines are drawn. School and student enrollments, school capacities, ethnic diversity, school walk zones, and topography are but several factors that must be weighed when reconfiguring school boundaries.

School Enrollments

School enrollments (the total number of students at each of the schools in the district) are dynamic, continuously changing. Students move to different locations within the district. With students constantly on the move, keeping track of where they are and where they go, can be a very daunting task. Some school districts will analyze school enrollments at different times in the school year to see the effects those changing enrollments might have on the distribution of students across the district. Creating a balance in enrollments among all schools is an important consideration for many districts when changing school boundaries.

Student Enrollments

Student enrollments (the total number of students in the district) will vary, as well. Enrollment forecasts will have a big impact on boundary planning for school districts that are growing or declining rapidly. When more families move into an area, the school district must be able to accommodate the new students. Growth should be taken into account when devising boundary plans so school districts can better assess the adequacy of school facilities.

School Capacity

School capacity can be another key factor to consider. School facilities can only hold so many students because of physical space and some states have laws governing the number of students a classroom should hold. In California, an initiative was passed to create the K-3 Class Size Reduction Program. School districts enrolled in the program are rewarded monetarily by reducing the number of students in a classroom to twenty for grades Kindergarten through third (California Department of Education n.d.). If school capacities are exceeded at some facilities, then the district can assess whether new schools need to be added, portables are needed, or whether existing school boundaries should be modified.

Ethnic Diversity

Some school districts have laws governing the assignments of students to schools based on ethnicity. Sometimes certain ethnic balances must be achieved among

designated schools in the district. Knowing the ethnic breakdown in certain geographic regions will help plan for diversity.

Distance to School

Walking distance from home to school is another key factor. Some school districts will provide bus transportation for students outside of a designated walk area. Students living within the walk area either walk to school or need to find alternate transportation (Figure 4). Planners may wish to examine school walk areas in relation to school boundaries for transportation purposes.

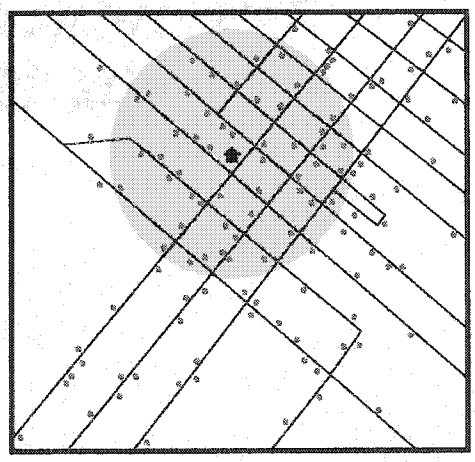

Figure 4. A school walk zone

Topography

Topography, though not considered a variable because of its usual lack of change, is a very important factor when deciding where school boundary lines will be drawn. Geographic boundaries such as rivers and freeways, create hazardous and impassible

obstacles for children walking to school. As an example, students would not be able to walk to school if they had to cross a river. Transportation could also be a problem if parents and bus drivers cannot find passable driving routes to and from the school (Figure 5).

The urban landscapes of inner city schools can pose problems, as well. As with subdivisions, neighborhoods are usually set apart from one another in some way, but in inner city areas demarcations are sometimes difficult to determine. Parents protest loudly when their neighborhood is split into separate school attendance areas. This makes the job of changing school boundaries a delicate one. As an example, a student might live right around the corner from a school, but because of school overcrowding he has to get on a bus and travel to a school more than a mile away.

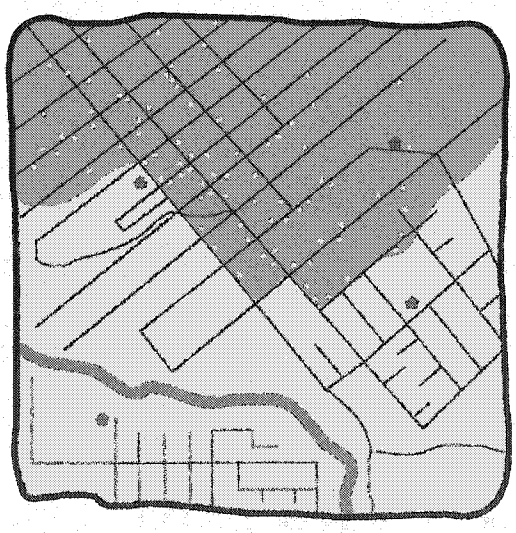

Figure 5. A river serves as a geographic boundary between school attendance areas

School District Policies and Decisions

Boundary plan options are created for analysis when a school district decides that school boundaries should be reviewed or changed. Policies dictating how boundary projects are handled can differ among school districts but usually the desired outcome is the same: to make the best determination as to where boundary lines should be drawn, designating to which schools students are to be assigned. Parties involved in the process can include school district administrators, planning staff, a board of elected school officials (the school board), and the community as a whole or as part of a planning committee. Generally, the boundary planning process begins with ideas or questions, continues with modeling and evaluation, and then concludes with decisions and implementation.

At the Harrisburg School District in Pennsylvania, the decision to redistrict comes from the Superintendent of Schools. The boundary planner creates boundary plans to be presented to the superintendent who then makes the final decision (Cowan 2003). Other school district policies require that the community be involved in the decision making process, as in the Fontana Unified School District in California, where a committee of citizens works with the school district to shift boundaries (Planware Systems 2001, 3). In some school districts, the boundary planning process is a complicated one, as in Henrico County Public Schools in Virginia. Data are gathered and analyzed, boundary scenarios are created and reviewed with an attorney, then a recommended plan is developed and reviewed with the Superintendent, as well as with other school district administrators. A

meeting is held with the principals of the affected schools, information is sent to the PTA (Parent Teacher Association) presidents, meetings with interested civic groups are held, and then a public hearing is held with school district staff, school district administrators, the school board, and the community. The school board makes the final decision, which is announced at a later date (Henrico County Public Schools n.d.).

No matter what steps are involved, how difficult the process may be, and whether it is the superintendent, the school board, the planning staff, a committee of parents, or all of the above, a decision should be made as to which plan best suits the needs of all parties involved.

Boundary Planning Issues Before GIS

Many school districts have made the decision to switch over to GIS-based systems for boundary planning to replace planning techniques they felt could not adequately complete the tasks set before them. The boundary planning process was very time consuming, not very accurate, not very well-informed, and prone to emotional and political persuasions. Boundary line locations are emotionally charged issues for parents of children attending schools and politically motivated issues for school district administrators wanting to keep their jobs.

For many school districts, inefficiency and inaccuracy was due to lack of resources such as staff, adequate maps, and reliable data, making the boundary planning process difficult. The ability to create alternative plans or scenarios for analysis was in most cases very limited. Having only a limited number of scenarios to choose from did

not make for a well-informed decision as to which plan best fit the needs of all parties involved.

Before obtaining a GIS system, the Harrisburg School District did not use maps directly in the process of deciding where to redraw boundaries because maps at the scale they needed for boundary planning were not readily available. All research was done manually. Information was extracted from their student information system, Pentamation, and decisions made based on the research they conducted. Many hours were invested and much money spent employing staff to complete the task of boundary planning each year (Cowan 2003). The boundary planning process for the Harrisburg School District was not very efficient in terms of time or staff resources, which equated to a loss of money for the district.

Before implementing GIS, Fayetteville Public Schools in Arkansas, used a separate wall map for each of their elementary schools and colored pins to mark the residency of their students (Fayetteville Publics Schools n.d.). This allowed them to see student distributions in each school attendance zone and gave them the ability to count pins to determine how many students lived in certain areas. The process of looking up each student address from a list and then placing a pin in the correct location on the wall map was very time consuming. Accuracy was probably an issue depending on the quality and scale of each map, the reliability of student address lists, as well as the precision with which pins were placed on the map.

The Fontana Unified School District and a committee of thirty citizens used photocopies of maps, highlighters, and calculators to manually draw boundaries at

planning meetings (Planware Systems 2001, 3). With the number of students in the district somewhere in the middle 30,000s, boundary planning using simple tools and with a committee of parents was not an easy task. Coordinating the meeting between thirty people, all with input about the placement of boundary lines, made for an emotionally charged environment. Decisions on the important issues facing the district could not be adequately addressed in such a hectic forum.

Many school districts have, in the past, manually coded student records with planning area numbers, based on their addresses, for producing tabular reports to use during the boundary changing process (Environmental Systems Research Institute n.d.). This type of process did not involve the mapping out of students with pins for spatial analysis, but was more of an accounting type procedure. Using a spreadsheet, students were counted and sorted according to planning area numbers. The planning area numbers were obtained by referencing addresses in street directories, and were then attached to each student record. This method of coding students was very time consuming and highly susceptible to data entry error. Accuracy of the reports was questionable, as was the result of subsequent analyses.

Before a GIS system was put to use by the Blue Valley School District in Kansas, maps and reports were prepared for boundary meetings by district staff beforehand. Meetings with the committee would result in the need for alternative plans to be drawn up for the next meeting. The staff would have to recalculate everything and prepare new maps and reports for the following week. The boundary planning process would be delayed a week each time committee members felt changes needed to be made

(Environmental Systems Research Institute 1997). The process of creating new maps and reports every week was time intensive. District staff and the community were lacking good communication and interaction during the boundary making process, which resulted in inefficiency.

GIS as a Solution

Implementing a GIS for boundary planning can help to solve the problems associated with manual boundary planning techniques. GIS can increase efficiency and accuracy, help to improve communication and interaction between decision makers, and create more options to analyze to assist in making better-informed decisions. The next chapter describes the use of GIS for school boundary planning and how it can be beneficial in solving the problems associated with previous boundary planning techniques.

CHAPTER 3

BOUNDARY PLANNING WITH GIS

A school district administrator describes his thoughts on GIS for school planning, "From a school planning perspective, GIS can best be described as a system that allows for the capture, storage, retrieval, analysis, and display of spatial data for the purpose of advancing school planning activities" (Slagle 2000, 3). Debbie Bicknell of Planware Systems, describes the benefits of using their GIS-based MasterPlan™ Suite for school district planning, "The planner will be able to use the full range of his/her creativity to devise optimum solutions to the district's problems. The software helps make the planning process faster and easier, while giving the planner a powerful tool to solve the district's problems" (Planware Systems 2003).

Elements of a School District GIS

GIS is comprised of four primary elements: software, hardware, human resources, and data (Slagle 2000, 4). The school district studies and considers these four elements when deciding to develop a GIS system. Once developed, the GIS will be capable of providing the school district with many helpful tools, some of which can be used effectively to improve the boundary planning process.

Software

Software packages for school district boundary planning are available from several different companies. The cost of software and the capabilities of each system vary quite a bit, as does the price. Decisions regarding software will usually be a balancing act between cost and capabilities. ESRI has several different software solutions available for school planning that have different features, capabilities, and price tags, but for some school districts their school planning capabilities might not be adequate. Several software companies have become ESRI business partners and developed software extensions that further enhance the capabilities of ArcView GIS and ArcInfo for school district planning. The Omega Group, Davis Demographics & Planning, and the Digital Engineering Corporation are three companies that have created ArcView GIS extensions for boundary planning. Some school districts have also developed their own applications to enhance the capabilities of ESRI GIS software. The Transfinder® Corporation, School Facilities Planning & Management, and School Vision Software have all developed boundary planning software that further enhance the capabilities of MapInfo®. Other companies have developed proprietary GIS software specifically designed for school district planning. Planware Systems, VersaTrans, and Education Logistics have created software for school districts that use proprietary map and data formats.

Hardware

Computer hardware and operating system requirements vary among GIS software vendors. School districts will sometimes purchase new computer hardware with the necessary operating system based on recommendations of the software vendor. Some school districts might want to use existing resources and will purchase a GIS system that works well on the computers and operating system currently being used. Other districts desire network capabilities so multiple departments can share the system. School districts will also need to consider other hardware devices or peripherals such as printers, plotters, scanners, tape backups, and projectors.

Most GIS systems purchased by school districts today are run from stand-alone or network desktops on platforms such as Windows®, Macintosh®, and UNIX. Some districts use client-server configurations for use on networks. Thin-client configurations using centralized servers and dummy terminals can solve firewall problems, hardware processing and data storage issues, give users remote access, centralize and simplify software upgrading, increase application reliability, and save the district money on hardware, maintenance, and security (National Semiconductor Corporation 2001, 1-2).

Human Resources

School district staff availability will most likely be a big factor in determining which vendor to purchase software from. Most school districts face budget constraints, limiting the amount of funds for personnel to staff new projects. The fewer people needed

to run the system, the better for most districts. The selection of appropriate staff members is also important. Formal training in geography or computer science is usually not needed, but an understanding of how to think spatially would be necessary (Slagle 2000, 6).

The school district will also want to assess the level of cooperation they will get from participating district departments and other resources when it comes time to gather the necessary data to input into the new GIS system. District departments sometimes have competing agendas. A continued commitment to the new project should be obtained to ensure it gets completed within the appropriate time frame. Consideration should be given to the stability of leadership and how this could affect the outcome of the finished project. School districts have a tendency to change leadership roles quite often. "Urban districts have historically experienced rapid turnover of superintendents and key administrative positions, including administrators in charge of school facility improvement programs" (DeJong and Glover 2003, 12). Sustained leadership with a common goal in mind is important to the success of the GIS program.

Data

The variability in GIS data standards and requirements that exists in other applications also exists for school district planning. Data formats and requirements are different among software vendors. Some systems can convert data from different sources into formats compatible with their systems.

The basic forms of GIS data exist as digital map layers (the spatial components) and electronic data files (the nonspatial components). "Spatial data is organized around a system of location that ties all data together" (Slagle 2000, 4). The spatial and nonspatial data components, when linked together, can be queried and analyzed (Figure 6).

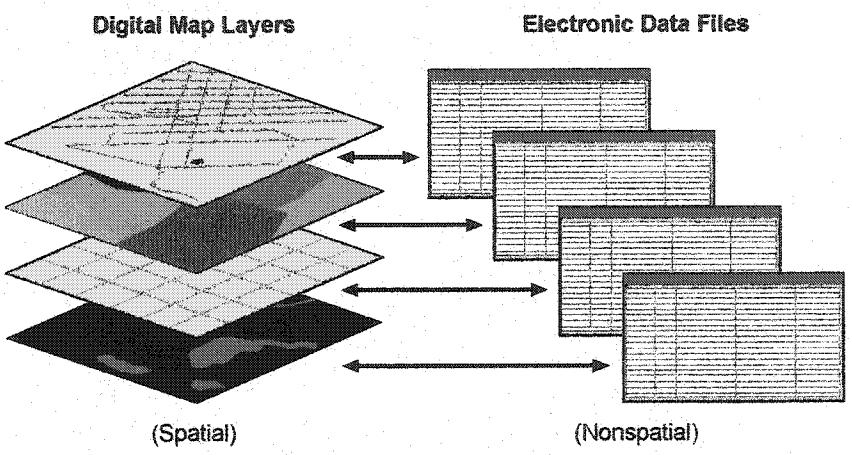

Figure 6. Linking of spatial and nonspatial components

Digital map layers are not just pictures of maps to be viewed on a computer screen. Digital map layers have associated attribute tables describing map features in database format. Tables contain information and numbers describing the specific geographic feature being represented. The way the data are displayed graphically depends on the type of data structure used. Vector data structures consist of points, lines, and polygons. Raster data structures use pixels or cells. Most school district GIS systems use the vector format because exact coordinates are needed for point locations such as student

addresses. Map features are usually organized into sets of layers. Points, lines, and polygons are stored in separate layers. As an example, streets (line features) would comprise one layer and school sites (point features) another.

Electronic data files are usually database files containing nonspatial information in tabular format. Tabular database files could include information about students, schools, parcels, or land use (Figure 7).

NAME	ADDRESS	CITY & ZIP	GRADE	GENDER
John Sikes	555 Lake Blvd	Lakeport, 97322	1	M
Fred Kilms	45685 12th St	Lakeport, 97321	K	M
Deanna Po	23 Hawk Ln	Golden, 97345	2	F
Tim Johns	7842 Lakeport Dr	Lakeport, 97322	6	M
Paula Szank	1122 Vista Del Agua	Lakeport, 97322	4	F
Hoyt Stark	59241 Campos Dr	Lakeport, 97322	1	M
Vern Polman	8884 Lakeside Ct	Lakeport, 97321	K	M
Suzi Trask	12 Aspen Wy	Golden, 97321	5	F
Kim Darcy	12369 Polk St	Lakeport, 97333	3	F

Figure 7. A sample student file

Before developing a GIS system, school districts need to assess whether they can obtain and provide the necessary map and tabular data needed to build a functional system. At a minimum, districts should be able to provide maps showing their existing school attendance areas, information and map locations of the schools in their district, and a file containing student information.

Customizing a School District GIS

Data Collection and Preparation

Once a software package is purchased, data are collected, imported, and customized for each school district before the software becomes functional. Depending on the system purchased and the arrangements of the contract, data collecting and preparation could be completed by the vendor or by the purchaser.

The necessary maps, digital map files, electronic data files, and other pertinent information are collected. "In order to use GIS to its fullest potential, data need to be collected from a wide variety of sources. Data can be acquired from school, city, county, state, and federal departments" (Cropper 2003). At least one digital map file is needed in order for the system to be functional, street centerlines including address range information. This file can be obtained from city, county, or state GIS departments or geographic data suppliers like Geographic Data Technologies (GDT), ESRI, or Tele Atlas. Other digital map layers can be used if they are in the correct format for importing or if the system is capable of converting them.

Data preparation steps and the sequence of those steps differ among vendors, but generally, data processing is the same. Digital map layers like street centerlines, city boundaries, and census tracts can be imported or scanned into the system. Other digital map layers like school boundaries are digitized if not already available in digital form. Some boundary planning software use small geographic planning units called *planning areas* to allow for more flexibility when making boundary changes to school attendance

areas (Planware Systems 2001, 1). School attendance areas are divided into smaller sections by digitizing interior boundary lines (Figure 8). Planning areas usually separate streets into logical groups, like subdivisions or neighborhoods, and are assigned numbers. Once created, planning areas are assigned to schools based on maps provided by the district and will inherit the color of the school they are assigned to. Planning areas that display the same color are assigned to the same school. Student counts for each planning area within a school attendance zone are then used to calculate school enrollments.

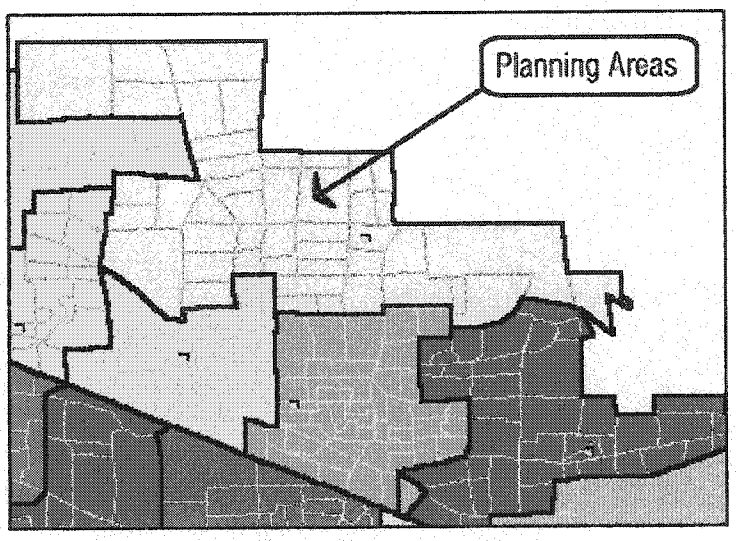

Figure 8. Planning areas divide school attendance areas into smaller planning units. Extracted, by permission of Jamie Panian, ©Planware Systems, LLC.

When the map work has been completed, the desired electronic data files are imported. This could include a student file, a parcel file, or a school file. Many school districts have centralized student information systems in place where student information such as name, address, grade, ethnicity, phone number, bus code, and gender are entered

and recorded. SASIxp™, a leading student information system developed by Pearson Education Technologies, can create reports or export files containing the student information needed for boundary planning purposes (Pearson Education Technologies n.d.). Student files containing street addresses can be geocoded to the digital street map. The geocoding or address matching process marks student locations on the map for viewing, but also attaches map screen or latitude/longitude coordinates, along with a planning area number, to each matched student record. Student counts can then be calculated and reported for designated geographic regions, such as planning areas and school attendance zones. Once all of the desired electronic data files have been imported and processed, the GIS system becomes functional. The user will have the ability to manipulate and analyze data that have been imported into the system.

Data Analysis

With data preparation complete, the system will produce reports and maps for analysis. Spatial analyses of student populations can be carried out. For instance, if students were color coded according to the schools they attend, maps could show where students are living in relation to their schools to determine if the enrollment is adequate for a particular school (Cropper 2003). Reports can be generated to show statistics such as school enrollments, school enrollments by grade, ethnic percentages, student counts per planning area, and student counts within school walk zones. Other types of reports can be generated listing student names and addresses by school or planning area.

Maps can be produced displaying different map features. Maps can show the distribution of students across the district, student density per planning area, parcels according to housing type, and student count enrollment changes (Figure 9). Used together, reports and maps are very useful for understanding the existing configuration of a school district. GIS is a powerful tool for school boundary planning because analysis can go beyond the present. Data can be manipulated to create *what-if* scenarios.

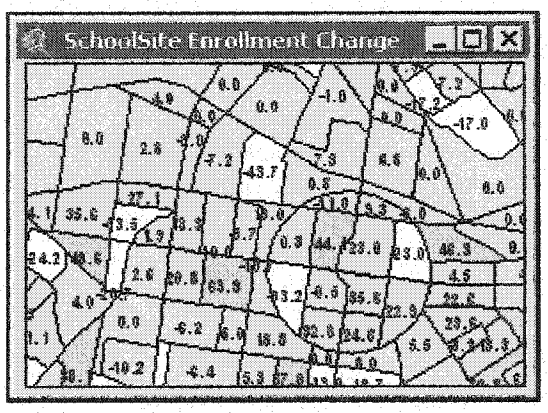

Figure 9. SchoolSite™ displays student count enrollment changes by study area. Reprinted, by permission of Greg Davis, ©Davis Demographics & Planning, Inc.

Data Manipulation

Two advantages of using GIS to create scenarios are that changes can be made easily in most cases and the results of those changes can be seen instantaneously. Most software packages allow changes to be made and saved as separate projects or scenarios, keeping the base data intact. Maps and reports are updated automatically by the system, so the results can be reviewed right away. Software capabilities and what can be asked of

the system differ among vendors. Most software can automate common tasks, making it easier for the user to create simulations. Some scenarios can be created with only a few clicks of the mouse. Examples of possible simulations would be changing school boundaries in order to balance school capacities or opening a new school with a new school attendance area.

GIS Improves Previous Planning Issues

The boundary planning process using older manual techniques is not very efficient and susceptible to data inaccuracies. Decision makers are sometimes not as well informed as they could be because of a lack of communication and interaction during the boundary planning process. GIS can be used effectively to help solve these problems.

Improving Accuracy

GIS can improve the accuracy of school district boundary planning. Because of the spatial nature of boundary planning, maps have typically been used in the process. Maps are effective communication tools as they can show patterns and trends that can bring a clear understanding about how school district services and policies are connected to the homes and neighborhoods in a community (TIES 2001, 1). Previous planning methods using paper maps and pins were relatively static in nature and probably not very accurate in some cases. Editing inaccuracies or making changes did not come easily. Student distributions on the map were the basis for analyses completed afterward. The accuracy of the pin map depended on the accuracy of student addresses, the scale of the

map, how well streets were depicted on the map, and the precision with which each pin was placed. Instead of using a paper map, a GIS system uses a digital street map layer, usually already digitized by an outside source. Inaccuracies can still occur in the digital street map, but these inaccuracies can be corrected in the system and the corrections will only have to be made once. New streets can be added as needed and the same street map layer can be used over and over again. Instead of using pins to mark student address locations by hand, an electronic student file containing address information is imported and automatically geocoded to the digital street map.

Improving Efficiency

"With the use of Geographic Information Systems (GIS), decisions that once required weeks and months of planning can be made in seconds" (Cropper 2003). Although initial data collection and system preparation for the new GIS can take some time, once the system is functional, performing analyses and creating different boundary plan options is much more efficient than older methods. Creating pin maps can be a difficult task. Making changes to those types of maps is even more difficult. Creating multiple maps for comparative analysis greatly lengthens an already time-consuming process. Sometimes districts do not have the resources or time to create an adequate number of alternate plans. The ability to make an intelligent choice based on only two options may not be possible. When it comes to urban policymaking, decision makers, when faced with a choice of only two options, tend to pick the better of the two options instead of rejecting both plans and seeking alternatives (Rothblatt 1974, 89). With most

GIS planning software, once all the data has been entered into the system, manipulating that data to create multiple boundary scenarios is relatively easy. Because GIS increases efficiency, more boundary plan options can be created and better-informed decisions can be made. Increased efficiency usually means money saved. When the economy is suffering, school district budgets normally follow suit. Minimizing operating expenses while getting better results would seem to be a very important issue for most school districts.

Enhancing Communication and Interaction

Better communication and interaction between decision makers during the boundary planning process can be accomplished by using GIS software. GIS is improving the interaction between decision makers with the ability to create boundary plans on the fly and to analyze them immediately. In boundary meetings with the school district, the school board, the committee, or the community, a computer workstation with access to the GIS and a projector can be used to interactively analyze and model boundary planning scenarios. Criteria can be changed and different boundary configurations created. Maps and reports for each scenario created can be analyzed and discussed during the meeting. All parties involved will feel a sense of empowerment because they have had some input in the process and will then better understand the decisions eventually made because they have been able to see firsthand the impacts of certain configurations; why some options work and why others do not. Better

communication between all parties in the decision making process can help to ensure that the final determination was made in the best interests of everyone.

Another added benefit resulting from the use of a school district GIS, is better communication with the non-participating public. Maps and reports derived from the use of the system can be posted on school district web sites to keep the public informed. Some school districts have even gone a step further and have used the data sets created for school planning purposes to create an Internet mapping tool. ESRI developed ArcIMS to deliver GIS and mapping services to the public using a web browser. School districts have taken advantage of this technology to allow their communities to display, query, and analyze school district data.

Issues Surrounding the Use of GIS

As with any other major implementation decision, the drawbacks of purchasing and implementing a GIS system for school boundary planning should be weighed against the benefits. Cost, preparation and setup time, accuracy, data compatibility and conversion, and technological support should all be considered in the decision of whether to implement a GIS system or which system to purchase.

Cost

The cost of GIS software depends on the system purchased and can range from thousands of dollars to ten of thousands of dollars. When school district budgets are low or the economy is bad, school districts cannot justify the cost even when they realize the

benefits of such a system. Another cost related hindrance would be the necessary hardware for the new GIS system and the employment of staff members to install, configure, and run the system.

Preparation and Setup Time

With the help of GIS, the time it takes to actually run and utilize the system is improved, but initial implementation, data collection and system preparation, can take a considerable amount of time. A handful of factors can affect the time it takes to get the system up and running, such as available staff, the size of the school district in terms of student population, geographic extent and density, as well as the level of cooperation received from needed participants.

Accuracy

Even though GIS is more likely to improve the accuracy of data and decisions if the correct procedures are followed, especially data verification, the possibility of inaccuracies still exists. The assumption that computers are infallible can lead to problems with accuracy. Map and student data are at some point hand entered by someone and converted into electronic format. In the case of street data, the base file is usually purchased from a company that sells street data for GIS purposes, like GDT or ESRI. These companies offer nationwide street coverages that are created and edited by technicians who probably know very little about the areas they are working with. If the street file is not checked for errors, then it is possible that bad decisions can be made

from inaccurate data. Data entry errors in student data by the school district can also be a problem.

Data Compatibility and Conversion

Data standardization problems exist between GIS school boundary planning software vendors. File formats sometimes cannot be converted from one form to another easily, if at all. The biggest file conversion problems exist with map layer data. If a school district were to have map data already in one format, they would probably want to use that data in the new GIS system to save time during the initial setup phase. If there is no way to convert the existing map data, new map data would need to be imported and updated by hand. For example, if map layer data for streets and address ranges needed to be imported from a new file, chances are those streets would need to be checked for accuracy and editing done to fix errors or missing street data. This process takes time, the amount of which depends on the extent of the street coverage and the degree of errors found.

Technological Support

Purchasing GIS software for boundary planning does not always assure that all boundary planning problems can be solved. Many different factors can come into play when modeling different boundary options. Limitations do exist as to what can be modeled because of data availability, software capabilities, and the technological confidence present in the staff running the system.

CHAPTER 4

REVIEW OF SCHOOL DISTRICT GIS IMPLEMENTATIONS

School Districts Using GIS

School districts are now using GIS to make better decisions about challenging issues facing their districts. In an article titled "Boundary Panel Gets Its Feet Wet," in the Chicago Daily Herald, published on 12 June 2002, Patrick Haldron reported that the St. Charles School District showcased a GIS-based computer system for drawing attendance lines to staff and committee members. The demonstration showed how boundaries could be changed instantaneously on the computer screen along with how those changes effected school enrollments. The district needed to plan for the opening of two new schools in the Thornwood subdivision in South Elgin and Cornerstone Lakes in West Chicago. The adding of two new schools would impact the already exiting ten elementary schools, three middle schools, and two high schools. With the public having much input about new school boundaries and with a boundary committee of over fifty members, the school district decided to use a GIS system, so that communication and interaction could be improved in the process of drawing new attendance zones.

Davis Demographics & Planning in Corona, California, has created a redistricting extension for ArcView GIS to modify or create new school attendance boundaries. Their SchoolSite™ Redistricting software uses study areas when simulating boundary plans with the capability of reassigning those areas to other schools to balance enrollment and

site capacities (Davis Demographics & Planning, Inc. n.d.). The Corona-Norco Unified School District in Riverside County, California, used ArcView and SchoolSite to plan for the opening of six elementary schools, one intermediate school, and one high school. Tremendous growth in student population over the past ten years and class size reduction initiatives, required the placement of over 485 portable classrooms. Adjustments in attendance area boundaries were needed to balance student enrollments throughout the district. Lynda Jankel, manager of the Facilities Planning Department at CNUSD, says, "The use of ArcView and SchoolSite has saved time, time, and more time. The use of GIS provides a quick response to staff and community queries and makes many needed planning tasks possible with a small staff" (Environmental Systems Research Institute n.d.). The improved interaction between decision makers helped to make the boundary planning process more efficient.

Planware Systems, a leading provider of GIS-based boundary planning software for the past ten years, has worked with more than 100 school districts nationwide, most of which have purchased their software to replace manual planning techniques (Bicknell 2003). The Harrisburg School District has used Planware Systems boundary planning software, ONPASS®, for the past six years to move school boundaries. The district has changed its boundaries every year since obtaining the software in order to continue school building renovations for compliance with current standards. With buildings closing for renovation, students had to be sent to other schools. Parents protested when their children had to be bussed to other schools. ONPASS was used to adjust the school

boundaries to avoid over crowding during renovations, but also to minimize the number of students moved to other school sites (Figure 10).

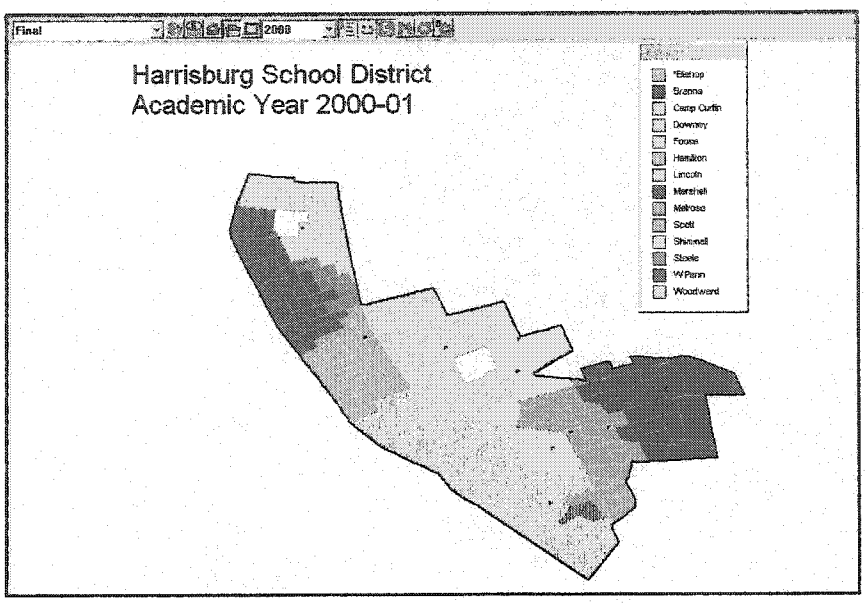

Figure 10. Harrisburg School District's approved boundary plan for 2000-01. Reprinted, by permission of Joseph Cowan, ©Harrisburg School District.

Joseph Cowan, who has been involved in the boundary changing process in the Harrisburg School District for the past five years, had this to say about boundary planning and the district purchasing a GIS system, "We used to do everything manually. This involved thousands of man hours and large sums of money. We would have to employ several different people to complete this task. With the purchase of the GIS software, we now have 1 person doing all the redistricting and an assistant to that person" (Cowan 2003). The GIS improved relations with the community by minimizing the

number of students transferred during renovations and improved efficiency in the boundary planning portion of a very lengthy district-wide renovating project.

In 2000, the Bloomington School District decided that a new middle school was needed. District staff used GIS software to create four different map options. A map of each option was placed on the school district web site so that a committee of parents could analyze the different boundary plans. GIS was able to provide parents in the community a better way to communicate and participate in the boundary changing process. The committee selected a modified version of one of the plans and recommended it to the district superintendent. The accepted plan later appeared on the district web site (TIES 2001, 2).

In 1988, the Blue Valley School District obtained and developed its first GIS system for school planning applications. The system offered significant but limited analytical abilities. In 1994, the district switched to a UNIX-based system, an ARC/INFO GIS application suite for boundary planning and enrollment projection modeling. Student Enrollment Decision Support System or SEDSS, developed with the Arc Macro Language (AML), greatly enhanced the ability to effectively reconfigure school boundaries. During the 1990s, school district enrollment had increased by 136% (Slagle 2000, 2, 9). SEDSS was developed so that members could look at different boundary options during public meetings and instantly see the results of changes they made. Planning Manager Michael Slagle says of the GIS system they developed, "SEDSS has improved communication and understanding among committee members, parents, and the school board" (Environmental Systems Research Institute 1997). With better

communication, the community has come to better understand the process of boundary planning and how decisions are made. Overall trust in the decisions being made increased, as well. Public planning meetings that were once filled with emotion and disagreement have seen a reduction in conflict over boundary decisions.

In September 1999, a federal judge ordered Charlotte-Mecklenburg Schools in North Carolina, to stop using race as criteria for student placement. They had one year to comply with the order and to draw new school boundaries for the 140 schools in the district. MapInfo GIS software was used to map student locations, to analyze the county map, and to determine where boundary lines should be drawn, so that schools would not exceed their capacities. Susan Purser, Associate Superintendent for Education Services, says this about the GIS software they used, "The MapInfo software helps us make decisions faster and with better information" (Pierce 2000). GIS has accomplished more than aiding in the redrawing of school boundaries by improving efficiency, but has also helped the district communicate its plan to the community. Displaying the proposed boundaries on the district web site provided an opportunity for parents to be informed about the boundary process, so that they could respond with comments. According to Susan Purser, "Our whole process for communication has been critical to the success of the plan" (Pierce 2000).

In the Fayetteville Public School system, GIS technology replaced time-consuming pin counting techniques to assign students to schools and buses. A GIS program was implemented to assist staff and administrators in improving efficiency and effectiveness in serving the needs of the district in regards to bus routing, attendance

zoning, and growth planning. GIS replaced the older "pin map" method of mapping student populations. Administrators can now locate students with more precision, increasing the overall accuracy of the boundary planning process. To improve communication with the public, the district created a web site for their *District Interactive Attendance Map*. Using ArcIMS, the Internet GIS enables the public to display and query different map layers like city boundaries, streets, school sites, and school attendance zones (Fayetteville Public Schools 2003).

The City of Westerville, Ohio, won a 2002 ESRI Special Achievement in GIS award for developing a community-wide GIS to assist city departments in making better decisions, increasing efficiency, and providing resources and information to the public. In two years time, GIS use in the city had grown from one department to eight. Continued professional development and hard work by all departments in the city, to generate and maintain data for the ArcGIS enterprise system, created a great tool and resource for many branches within the city, such as law enforcement, parks and recreation, planning and zoning, and school redistricting. The city also worked with the Westerville City School District to redistrict grades Kindergarten through twelfth. The GIS system helped the school district with planning and assessment efforts as well as with transportation planning. Currently, with help from an Internet Map Server, the city web site allows the public to view ten different map layers including a school layer showing school boundaries and school sites (Environmental Systems Research Institute 2002).

During the 2001-02 school year, Los Angeles Unified School District contracted with MRF Geosystems Corporation to build a web-based GIS to be used for several

tasks, one of which was school enrollment zone redistricting. Authorized users in the district could access the GIS through a web browser to change school attendance zones that were based on blocks, parcels, and streets. GIS tools were needed to automate the geocoding of 720,000 students in the school district, thereby increasing the efficiency of the boundary planning process (MRF Geosystems Corporation n.d.).

Education Logistics (Edulog), another national provider of boundary planning software, has been selling to school districts for twenty years. A testimonial given to Edulog by Kevin Harvill, Transportation Specialist at Denton Independent School District in Texas, praises Edulog for improving efficiency and accuracy in redistricting their school zones:

> Thanks to EDULOG for developing a demographic software system that was so instrumental in helping us here in the Denton Independent School District to successfully redistrict our school zones following the construction of a new elementary school. Without EDULOG and our knowledge of the area, I feel that the committee would have had an extremely difficult task of redrawing lines. EDULOG made the process quick and accurate. All members of the committee were very impressed and grateful that they had this tool at their disposal (Education Logistics n.d.a).

In Florida, the Palm Beach County School District has used various GIS tools to increase the flow of information about boundary changing activities to the community and to encourage parents to become involved in the attendance boundary process. From the district web site, maps of school attendance areas can be viewed using a Java Applet and downloaded as an Adobe® PDF (Portable Document Format) file. Free GIS data can also be downloaded and viewed using ArcExplorer (a free GIS data viewer developed by

ESRI). Using ArcExplorer, school district data can be displayed and queried with an intuitive, easy-to-use interface (Figure 11) (Palm Beach County School District n.d.).

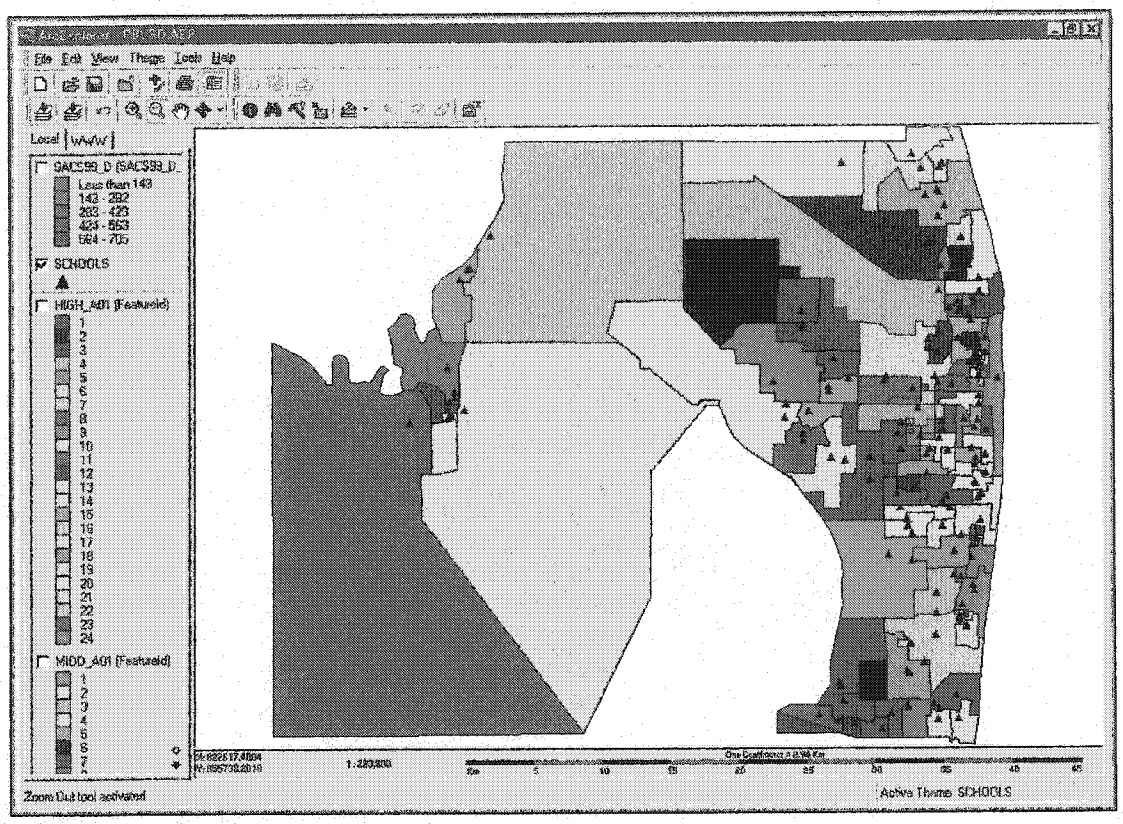

Figure 11. ArcExplorer displays elementary school attendance areas along with school site locations. AE project created by author using themes downloaded from the Palm Beach County School District web site.

Herman Hilkey, Director of Facilities Expansion and Special Projects at the Fontana Unified School District used GIS to improve the boundary planning process by improving communication between the school district and committee members. In an interview conducted February of 2001, by Planware Systems, he comments on how shifting boundaries with a committee of thirty citizens was always a big issue:

> Everyone used to have hand calculators, highlighters and maps. It used to be a real ordeal. We would be making photocopies of our maps and taping them together, using a highlighter to draw boundaries- there would be arguments as to whose calculator was right. They would get so tied up with numbers, calculators and highlighters that they would forget to talk about "What does the community really want? What's a safe crossing? As soon as we got ONPASS working and we brought up the screens that show a face where every student lives they become decision makers. Any questions that arise as to transportation costs, racial issues, whatever, I'm able to show them very quickly what they're asking for and we get it resolved right away (Planware Systems 2001, 3).

The twelve school districts mentioned in this chapter implemented GIS to address issues they had with the boundary planning process. In the next chapter, an evaluation is conducted as to whether the GIS improved any of the issues each of the school districts identified.

CHAPTER 5

IMPLEMENTATIONS TO SOLUTIONS

An Evaluation of Issues and Results

Twelve school district GIS implementations were reviewed in the previous chapter. These school districts chose to use GIS technology to solve issues related to boundary planning. The four major issues school districts faced when using old methods of boundary planning were inefficiency, data inaccuracies, poor communication between decision makers, and lack of interaction during the boundary planning process. Each of the twelve school districts identified the issues they hoped the GIS would improve (Table 1).

Issues:	Efficiency	Accuracy	Communication	Interaction
School District Name				
St. Charles School District				
Corona-Norco Unified School District				
Harrisburg School District				
Bloomington School District				
Blue Valley School District				
Charlotte-Mecklenburg Schools				
Fayetteville Public School				
Westerville City School District				
Los Angeles Unified School District				
Denton Independent School District				
Palm Beach County School District				
Fontana Unified School District				

Table 1. Boundary planning issues for each school district for each major group (identified in red).

As illustrated in Table 1, five of the twelve school districts identified only one of the four issues, while the rest of the districts identified two of four issues. None of the school districts named three or more of the issues. Of the four major issues, more school districts wanted to improve communication (Figure 12), while accuracy was not as much of an issue as communication, efficiency, and interaction.

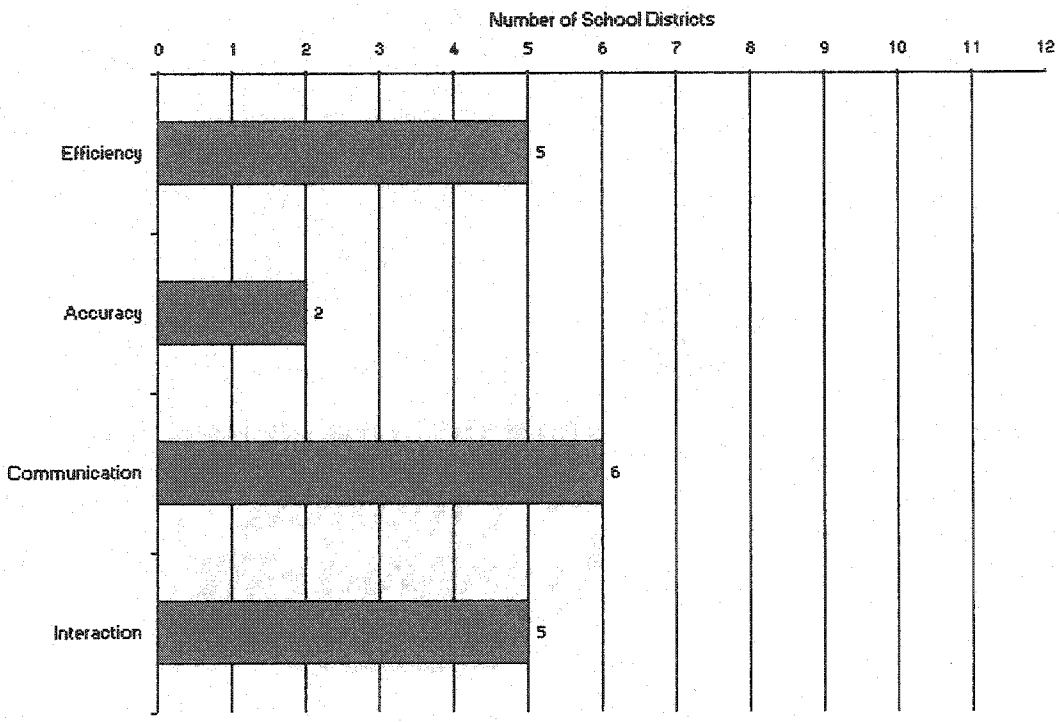

Figure 12. The number of school districts identifying with each of the four major boundary planning issues.

When comparing the issues school districts had with old boundary planning methods and the benefits derived from the use of a GIS, all but one of the school districts were able to improve on each of the issues they identified. Fontana Unified School

District did not indicate whether their issues concerning accuracy were improved (Table 2), but five of the school districts experienced benefits in addition to the issues they were hoping the GIS would address.

Issues & Benefits:	Efficiency	Accuracy	Communication	Interaction
School District Name				
St. Charles School District				
Corona-Norco Unified School District				
Harrisburg School District				
Bloomington School District				
Blue Valley School District				
Charlotte-Mecklenburg Schools				
Fayetteville Public School				
Westerville City School District				
Los Angeles Unified School District				
Denton Independent School District				
Palm Beach County School District				
Fontana Unified School District				

Table 2. The boundary planning issues each school district identified that were solved by the use of GIS are shown in blue. Issues that were not solved by the GIS are shown in red. Other benefits derived from the use of a GIS, in addition to the issues each school district identified, are shown in green.

An evaluation of the comparison between the identified issues with the benefits each school district incurred demonstrates that the implementation of a GIS not only achieved its desired goals but also exceeded expectation by improving efficiency and communication (Figure 13). GIS has improved the boundary planning process and despite the possible problems associated with its setup and use, school districts have been successful in implementing GIS solutions.

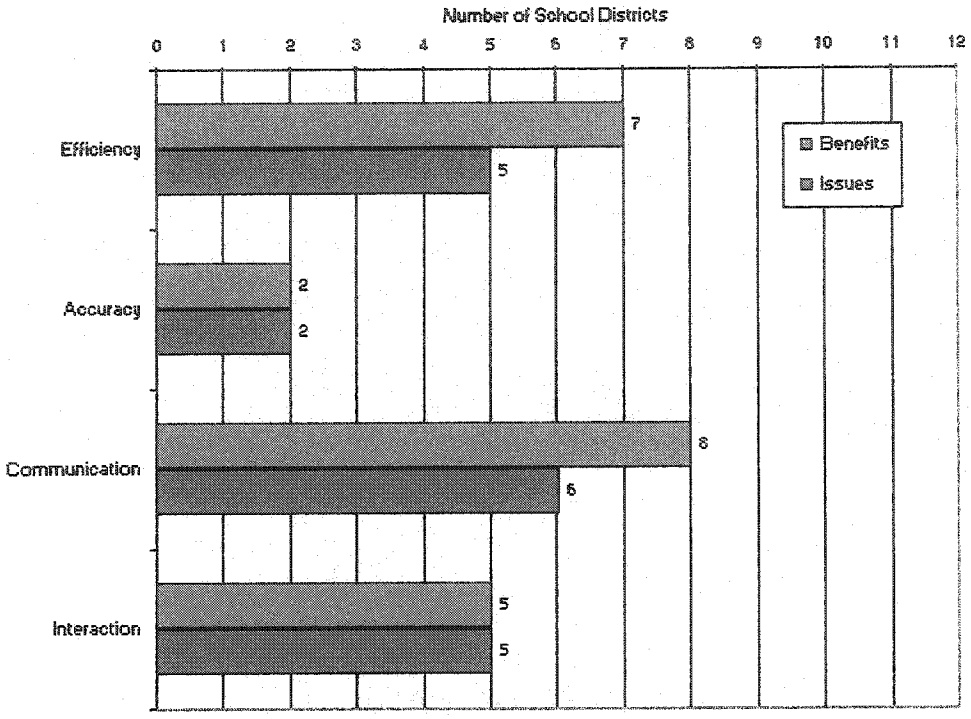

Figure 13. A comparison between the number of identified boundary planning issues with the number of benefits derived from the use a GIS.

Conclusions

Data-Driven Decisions

School district administrators have to make crucial decisions when it comes to changing school attendance boundaries. Emotionally charged issues surround the boundary changing process. Efficient, accurate, and well-informed decisions must be made for the betterment of the entire community. GIS, current technologies, and the availability of data for analysis, aid district planners in this process. The co-founder and

Chief Academic Officer of SchoolNet, Denis Doyle, has this to say about data-driven decision making:

> Today's education leader, whether the leader of the school district, the school building or the classroom, must change data into knowledge, transform knowledge into wisdom and use wisdom as a guide to action. But if data-driven decision making and scientifically based research are the necessary preconditions to wise decision making, they are not sufficient. True, without data and solid evidence the modern decision maker is helpless, but simply processing data and evidence is no guarantee of success (Doyle 2002).

Though the benefits of GIS as a tool for helping planners and decision makers analyze data are evident, it is the cumulative knowledge of all persons involved in the process, as well as the results of data analyses, that ensure the best possible decisions are made.

APPENDIX

QUESTIONNAIRES

Part of the research conducted for this paper included the use of questionnaires. Two different questionnaires were created. The first questionnaire was sent to Debbie Bicknell at Planware Systems. The main objective was to determine why school districts are seeking GIS-based planning software. The second questionnaire was sent to Joseph Cowan at the Harrisburg School District. The main objective was to find out why the school district had a need to redistrict and the steps they took during the process.

The Results of Questionnaire for Debbie Bicknell

1. What company do you work for?
   Planware Systems, LLC.
2. What does your company do?
   Provide software solutions for school district planning.
3. What is your position in the company?
   Sales Manager.
4. How long have you been working with this company?
   Almost 3 years.
5. How long has your company been selling GIS-based boundary planning software?
   30 years.
6. When working with potential clients, what are some of the reasons they give as to why they are seeking GIS-based boundary planning software?

Potential clients are looking to save time and money. Usually they are doing their planning work by hand and want a quicker, more efficient way of doing their jobs.

7. Are many of the school districts you work with wanting to switch to computer software from out-dated manual planning techniques?

   Yes, the majority of the school districts that we work with are looking to switch to computer software from manual planning techniques.

8. Have any of the school districts discussed with you the types of old techniques they wish to shy away from?

   They want to be able to do their work on the computer using software that is specifically designed for planning versus doing the work by hand.

9. Can you elaborate on the types of old techniques they use?

   Some districts have used maps and pins to plot student demographic information.

10. Can you list some of the benefits GIS-based software will have for the school district planner?

    The planner will be able to simulate many situations, such as closing or opening schools, adding new classrooms to existing schools, and changing transportation policies.

    Once a student assignment plan has been generated the planner will be able to produce summary statistics, a variety of computer maps of student assignments, and a full set of detailed listings of the individual school assignments.

    The planner will be able use the full range of his/her creativity to devise optimum solutions to the district's problems. The software helps make the planning process faster and easier, while giving the planner a powerful tool to solve the district's problems.

11. Can you explain, briefly, how your software works?

    The MasterPlan suite is a powerful set of tools written in Microsoft "C", running under Windows NT, operating in a stand-alone or network environment. The heart of the system is a relational database to store, retrieve, and report street, boundary, school, bus stop and route and student information.

12. What is required of the school district?

The school district is required to provide a boundary map, school and site locations, school profiles, zip code lists, and district personnel information. The school district also needs to provide a student database file in ASCII format.

13. How many clients have purchased your boundary planning software?

    We have over a hundred clients nationwide.

14. Do you believe the cost of purchasing the software is a hindrance to some school district budgets?

    No, school budgets vary from district to district. Overall the majority of school districts realize the long term cost savings involved with the software purchase, and are able to justify the cost of the software.

15. Do the benefits derived from purchase of the software usually outweigh the initial purchase cost?

    Yes, the benefits derived from the purchase of the software far outweigh the initial purchase cost.

The Results of Questionnaire for Joseph Cowan

1. Who do you work for?

   Harrisburg City School District.

2. Where is your school district located?

   Harrisburg, PA.

3. What is your position in the school district?

   Technology Trainer.

4. How long have you been working with the district to do boundary planning?

   I have been involved for 5 years.

5. How long has your district been using GIS-based software for boundary planning?

   6 years.

6. Do you know why the school district decided to switch to a GIS-based program?

We did not have a planning system that we used prior to our current system. Everything was done manually, which required someone to research all the information on the Pentamation system. About 7 years ago, we decided to begin a very lengthy process of renovating our buildings to make them 21st century compliant. In the process of all the renovations we may have up to 3 buildings being renovated at one time. Without the necessary GIS planning system, it would have been impossible to plan which buildings would house which group of students and what transportation means would be necessary.

7. How many times has your school district been through the process of redoing the boundaries since you have been involved?

   We have moved boundaries every year since I have been involved.

8. Are there reasons why the district needs to redistrict at any given time?

   Our major reason is the whole renovation process. We will also move boundaries to decrease the number of students in a building if we feel the building is over-crowded or has the potential for over-crowding. In our city, we have a very large shifting of population from year to year. Not a lot of students move out of our district, they just move from one side of town to the other. In the past 2 years we have had a large influx of new students to the District. This has caused us the need to move boundaries more often to house the new students.

9. What has been your roll in the boundary changing process?

   I am the main person in charge of all redistricting. Every change made to the boundaries, is made by me. I have a team of people to assist me in things like building walk-throughs, transportation and crossing guards.

10. Briefly describe the general process of boundary planning starting with who decides to redistrict and ending with who makes the final decision on which boundary plan works the best?

    Basically every step in the boundary planning process is started by me. I am instructed by the Superintendent of Schools for the need to move boundaries. I begin my process by realizing which buildings will be under renovation for the following school year and decide where the students in those buildings will be housed. I then walk through all the buildings checking for space and getting a detailed list of how the Principal will be utilizing their building for the upcoming school year. Once this is in place, I begin the process of moving the boundaries in the GIS system and verifying the moves will not cause over-crowding. Upon completion of this process, a map and visual break-down of the District is presented to the Superintendent of Schools for final approval and student rosters are given to each building Principal.

11. Briefly describe the process of creating boundary plans or scenarios using your GIS software? What factors need to be considered? How long does it take?

    As previously discussed, I begin the process with a walk through of all the buildings, checking for space and obtaining a list of how the Principal will be utilizing the space in their building. When moving boundaries I have to consider any new students which may enter our District. These new students can shift a boundary from one building to another. I am also trying to establish some form of consistency. A couple years ago, we had a problem with parents picketing the Administration building and calling the Harrisburg City Mayor to complain about their child being bussed to a different school. I have been trying to refrain from moving boundaries unless necessary, just so a child will have some consistency in their education process. The entire process from beginning to end usually starts in September and ends in July. Once completed in July, we then send out letters to parents advising them of their child's placement assignment.

12. Do you feel GIS software has greatly helped to save your school district time and money when it comes to redistricting?

    Yes. As stated previously, we used to do everything manually. This involved thousands of man hours and large sums of money. We would have to employ several different people to complete this task. With the purchase of the GIS software, we now have 1 person doing all the redistricting and an assistant to that person. We have a committee of people who assist in the process of building walk-throughs, 2 people responsible for the transportation of students and 1 person responsible for safety and security officers. The process still takes about 1 year to complete, but this time will decrease as buildings are renovated and reopened.

GLOSSARY

Arc: A continuous portion of a curved line.

Arc Macro Language: The ARC/INFO programming language used for automating frequently used functions in ARC/INFO.

Cartographer: A person who makes maps.

Demarcation: The determining and marking off of boundaries.

Demographics: The statistical data of a population.

Digitize: To manually geocode points, lines, or polygons.

Firewall: Hardware or software solutions used to prohibit certain Internet data transmissions, such as hacking and messaging.

Geocode: Converting analog maps and data into computer-readable formats.

Geospatial: Having to do with geographic space.

Intranet: A connection of computer networks that can communicate and share resources, but only within a specified operating framework such a within business.

Java Applet: A program written in the Java™ programming language that can be included in an HTML page.

Node: Points of origination or termination.

Planning area: A series of connected lines encompassing a group of streets and the students living on those streets.

Polygon: An enclosed area of three or more connected lines.

Redistrict: Changing school district boundaries.

School attendance area: A geographic area surrounding or assigned to a school.

Socioeconomic: Pertaining to the combination of social and economic factors.

Spatial: Having to do with the space around you.

Study area: See *Planning area.*

Tabular: Data arranged in rows and columns.

Terminal: A *thin* or dummy computer workstation containing bare minimums for operation on a thin-client network: a microprocessor, network interface card, video subsystem, and memory.

Thematic map: A map with a theme depicting certain features or events, such as a density map.

Topography: The relief features or surface configuration of an area.

User interface: The tools a user employs to interact with the computer such as a keyboard, a mouse, and monitor.

Vector: A GIS data structure type consisting of points, lines, and polygons.

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