Supporting the Information Needs of Geographic Information Systems Users in an Academic Library

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SUMMARY

The growing use of GIS in university research and teaching environments has created a demand for data, software, and technical support that is best accommodated by a central GIS service provider. The library is a natural candidate for this role. While some academic libraries only provide GIS-formatted data, others offer exhaustive services from GIS courses to contract GIS work for students and faculty upon demand. This paper discusses how the Stanford University Library System has integrated GIS support into its suite of services offered to patrons across all academic disciplines. Two case studies illustrate how the library meets patrons' diverse and detailed GIS information and technical needs.

Keywords: GIS, academic libraries, spatial data

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Introduction

Technological developments are driving changes in every aspect of library science. One arena of technology that has made a large impact on university libraries collections and services is Geographic Information Systems (GIS). Libraries are seeing growing user interest in GIS and in response are changing their staff, services provided, and collection development policies to accommodate this demand. Each library may choose a slightly different method or degree of responding to the users' interests, but unquestionably GIS is demanding some reaction from all. Libraries must answer questions about how extensively and to whom they will provide GIS support services. How are other campus groups using and supporting GIS? What sort of software, hardware and data does GIS require? How can a library staff best assist students and faculty to meet their GIS needs? How much should the library staff provide support in-house vs. support via the Web? How will patrons be made aware of the library's GIS support services? This paper will address these types of questions by describing the GIS support in the Stanford University Libraries (SUL) system.

Background

Geographic Information Systems are sets of computer tools that facilitate the storage, retrieval, analysis and display of spatial data (Burrough 2001). Most data contain a geographical component, such as: a zip code, census tract, street address, city, county, or latitude/longitude coordinate. Using GIS, otherwise disparate data can be related on the basis of common geographic location, creating new information from existing data resources. Through GIS software, one can display, explore, and analyze data by location, revealing hidden patterns, relationships, and trends that are not readily apparent in traditional spreadsheet or statistical packages. Although one can produce high quality static maps with GIS, it is a dynamic system that allows one to select and remove any criteria on the map. This versatility assists with rapid analysis of the spatial variables affecting a system or model, ultimately assisting complicated decision-making.

Early use of GIS was primarily limited to researchers from geography and computer science departments. However, as GIS software has become more sophisticated, its pool of users has widened. In universities, researchers from a broad range of disciplines are seeing the benefit of this tool for analyzing their spatial data. The advantage of having a unifying GIS platform in which users may combine otherwise disparate data sources is attracting an ever increasing number of users. At Stanford University, students and faculty have used GIS for research in biology, earth sciences, civil engineering, political science, sociology, anthropology, history, electrical engineering and in over 20 other departments and centers across campus. Whether analyzing a digital elevation model, hydrologic network or census tracts, the benefits of collecting and analyzing information in a GIS are becoming more commonly known. .

Library GIS Services

SUL has adopted the role of being the central node for GIS support on campus. After visiting several other universities' GIS labs, the advantages of housing GIS services in the libraries became clear. At many universities, any department with students and faculty interested in GIS is required to provide its own software, data and technical assistance for its GIS users. Often this type of support first develops in a department such as geography, forestry, or earth sciences. Such departments, with large numbers of students interested in GIS, are usually able to satisfy their users' needs, but in departments where only a few students are interested in GIS, often little support is available. Also, this departmental model typically doesn't facilitate sharing of costs and data between the various GIS support nodes that simultaneously develop across the campus. A library's role is to collect and catalogue data such as those needed by GIS users. Providing GIS support through the libraries gives users from all departments equal access to services as the library is often in a central location with open access and long hours of operation.

Within the library system at Stanford, the GIS services were initially sited in the Branner Earth Sciences Library and Map Collections (Branner) because it served the departments who first expressed heavy interest in GIS and it houses nearly all of the cartographic materials for the library system (Derksen et. al, 2000). Branner Library supports the School of Earth Sciences and the earliest users of GIS were from its departments as well as from the Electrical Engineering Department and the Epidemiology Program. Therefore, the GIS support in Branner Library has been tailored to assisting patrons in the sciences. Stanford's Green Library Social Science Resource Center also provides GIS support with a focus on social science and humanities applications. The libraries at Stanford have proven to be a successful central location for providing GIS support to the campus as a whole.

It should be noted that adding GIS services in an academic library will increase demand on staff resources. This may include providing extra support hours, attending advanced training in GIS theory and methods, hiring student assistants to maintain Web pages and assist with repetitive tasks, and acquiring skills to manage computers with sophisticated programs and large amounts of data. Additional library staff are often required to meet the needs of GIS patrons. A GIS specialist would organize the GIS services, manage the GIS computers and provide technical support, while a GIS librarian would purchase, catalog and become familiar with the large amounts of GIS-formatted data now being produced. The GIS librarian will need to develop a central collection of GIS-formatted data that reduces the duplication of data acquisition on campus.

GIS Support at Branner

Patrons come to the library with different levels of knowledge and expertise in GIS. Some have heard about it, but have no clear understanding of the learning curve inherent in mastering the software. An information interview should be carried out in order to assess their needs and willingness to devote the time to learning a complicated software program. Often, if a patron wants a simple map with added points or labels for a report, an interactive atlas CD-ROM such as Microsoft Encarta or map publishing software such as Mountain High Maps, will more easily suit their needs.

At Branner, a library specialist consults with new patrons to help them decide if GIS is the right tool for their research needs. This specialist assesses each patron's comprehension of GIS, and directs her to tutorials, on-line instructional materials, and software manuals as needed. These resources offer an abecedarian introduction to GIS, meeting the patron's initial GIS needs. Most students are very efficient at using and incorporating the instructional materials. After the patron has completed one of the self-guided tutorials, further consultation is provided in the form of answering technical support questions, general project design or data acquisition assistance.

Many patrons aren't interested in becoming GIS experts, but rather would like the fastest, simplest way of making the GIS "tool" work to solve their particular needs. People exhibiting this learning style are sometimes resistant to the suggestion of completing a tutorial before asking for further assistance. Patrons may instead use trial and error methods or seek peer support when trying independently to answer their GIS questions (Young, 1979). Engineering students, for example, have occasionally found the introductions to certain GIS instructional materials simplistic and therefore abandoned the tutorial entirely (Freyberg, 2002). If this introductory GIS stage is skipped, important concepts are often missed or additional benefits from GIS may not be realized. Also, patrons who skip the self-instruction step often make more demands upon the GIS staff who provide technical assistance. Hence, the staff tries to encourage self-instruction by suggesting the most efficient, high-quality instructional materials available.

Data

Those who come to the library already knowing how to use GIS or willing to learn it, may need data, answers to technical questions, and help with project design. As is the case with paper maps, patrons often assume that GIS data in a readily useable format must exist if the data can be conceived. While this may be true for general small-scale data, it is not true with more specific data requests. For example, a student recently requested GIS files showing watershed boundaries, property boundaries, and addresses for a coastal Mendocino county. All of this information can be found, but not in the format desired. If a patron is willing to invest some time in learning GIS, the map layers could probably be created by manipulating Digital Elevation Models, parcel maps, or local government files.

At a large research university, the variety of research projects is enormous. Trying to anticipate all of the necessary data becomes an onerous and potentially expensive task. It can be handled more easily by first considering which basic GIS information will serve the largest number of users. It is important to have general data from the Census Bureau for socio-economic data, and from the United States Geological Survey (USGS) for elevation data, roads, rivers, and geology. Much of these data are available on the Web for free from government sites or through the Depository Library Program. There are vendors who produce valued-added products that manipulate the data in such a way that it can be more easily handled in a GIS. Commercial sources may also provide the specific data that users request. In selecting products, one should consider user demand, budget considerations, and copyright restrictions. Commercial vendors have a wide range of copyright restrictions ranging from fairly lax, where one can use the data on any workstation, to very restrictive, where viewing data is permitted on only one specific machine for the entire campus.

Base map data on a global scale is relatively easy to find, although not always inexpensive. Base map layers include political boundaries, major roads, cities and towns, waterways, etc. Typically, as data resolution improves, costs increase. The ESRI Data & Maps CD-ROM set, which is included in an ESRI campus site license, contains base map data for the world, with more detailed data for the United States. The USGS is releasing a collection of CD-ROMs in their Global GIS series that will provide a world-wide vector data reference at a regional scale (1:1,000,000). This set is free to Depository Libraries that chose to receive it.

In comparison, National Imagery and Mapping Agency (NIMA) is releasing Vector Map Level 1 (VMAP1), which has base map information at a scale of 1:250,000 in a non-standard format. A third party vendor is manipulating the data into standard GIS formats. So far, they have released 63 of 234 total zones at a price of between $50-95 per zone, depending upon how many are purchased. Some of these costs can be mitigated by collection sharing agreements. The University of California (UC) campuses and Stanford Map Library often purchase expensive data as part of a consortium. Stanford and most of the UC campuses agreed to purchase Landsat 7 imagery for the state (27 images) at $600 per image. The price was leveraged across the units, with those having bigger budgets paying for more images. Of course, this sharing can only be done if copyright allows it.

In an attempt to influence information-seeking behavior, a page on the Stanford GIS Web site (*http://gis.stanford.edu*) lays out guidelines for finding data. The first step is to search in Socrates, Stanford's online library catalog. The cataloging records for data received are modified with a local genre note stating that it is "geographic information systems data." This can then be used in a keyword search along with a geographic location or data theme. A partial list of GIS datasets held in the library, with descriptions, are noted on another Web page. Next, the patron is encouraged to search the online links to GIS data directories and warehouses, such as the GIS Data Depot and state GIS data clearinghouse sites.

The Internet is often a fruitful place to find data, but requires persistence and a keen eye for quality. Search engines, such as Google (*http://www.google.com/*), when queried specifically enough, can often return relevant results. GIS Web sites, like the list archives at Directions Magazine and the ArcView Knowledge Base, allow patrons to search for similar past data requests or to post their own query. Patrons are also encouraged to seek help from the GIS staff at Branner who offer searching expertise as well as a broad knowledge of the data available in a variety of places.

Those looking for data do not always employ such a systematic approach. Patrons often prefer to find their data online before looking in the library or searching on the GIS machines housed at Branner. Quality is often sacrificed in order to lower the "cost" of obtaining the information (Pinelli). This is problematic if the person only tries to find the right area and resolution for their data needs, say when looking for a Digital Elevation Model (DEM). The quality of data can vary widely, causing problems in accuracy that may not be discovered until the patrons use the data and get results they don't expect.

The librarian's role should include evaluating the quality of electronic information, an increasingly important function as the quantity continues to grow. Providing pointers to accurate sources of data on subject-specific Web pages helps to mitigate the problems found by simply surfing the Internet indiscriminately.

Finding foreign data is problematic at times. Data that is given to the public for free in the United States, such as data from geological surveys, must often be purchased from other countries. This is a source of frustration for the patrons, who then often come to the library to see if it is owned or if the library is willing to purchase these data. If other patrons will likely use the data and is consistent with the library's collection development policy, the library is often able to assist with these requests.

Very specific field data often are provided by colleagues rather than through library channels. It is not unusual for a patron to supplement these data with base map information from the library. For example, a patron doing fieldwork in Vietnam used a GPS unit to locate her study sites, and then drew polygons representing land use categories upon satellite images in a GIS program. This type of gray data is often undocumented and not captured by the library's collection strategies. It therefore stays completely independent of the library and is accessible only to members of the specific project.

Hardware and Software

Libraries offering a full range of GIS services should provide their patrons with high-end computers, large screen monitors, and a color printer. Copious amounts of server space are needed to store large data sets and the necessary GIS programs. Branner Library houses 4 networked, 1.5GHz Pentium PCs running Windows 2000 each with 40 GB of hard drive space. These computers are accompanied by 21-inch monitors, an HP color printer, a Contex 40-inch feed-through scanner, and a large-format HP plotter. The size of the computer lab will remain stable in the foreseeable future. GIS users at Stanford often prefer to work in their own offices, laboratories, or computer clusters. The library encourages patrons to use their own machines by providing easy access to online software and data, mitigating the need to acquire additional computer resources.

Branner's web site (*http://gis.stanford.edu*) allows Stanford affiliates to download unlimited copies of GIS software and data to Stanford-owned machines. This free access is subsidized by the libraries' purchase of an annual site license with Environmental Systems Research Institute (ESRI), currently the market leader for GIS software. In selecting GIS software for the library, Stanford University Libraries determined which software patrons most commonly use. ESRI makes popular GIS software such as ArcGIS and ArcView. Software has been downloaded from the site over 500 times to patrons from over 30 different departments since the service was first offered.

Outreach

Campus outreach is an integral part of the library services at Branner in order to increase awareness of the facilities and data in the library system. Selective outreach to different departments and groups across campus is done on a regular basis through a series of workshops. The workshops last about an hour and a half and typically have three components: a general introduction to GIS including a demonstration of the current ESRI software, a discussion of the data available through the library and on the Internet, and a guest speaker who discusses and demonstrates a relevant project. The workshops are promoted through departmental listservs, posters, and by word of mouth. This format has worked successfully for workshops targeting biology, health research applications, the social sciences, and the humanities. Upcoming workshops will highlight the use of Census 2000 data in GIS and GIS applications in business. These workshops have increased the GIS user base on campus and have stimulated demand for library services.

GIS outreach is also done through in-class demonstrations. These demonstrations are tailored specifically to the needs of the class and are done in consultation with the professor. In an Electrical Engineering class (described in the case study below) students are given a long introduction to the ArcView software to make them literate in its use, so they may quickly employ it as a tool for subject-related analysis.

To introduce students from all disciplines to GIS and its real-world uses, a course is held yearly in the Department of Geological and Environmental Sciences. Branner's GIS staff leads one session. The GIS Manager gives a general introduction to the software and shows the students how to download and import USGS DEM data. The GIS & Map Librarian focuses specifically on data, including how to find it in the university catalog, tips for effective Web searching for data sets, and a discussion of how to assess the quality of the data one finds.

Case Studies

Electrical Engineering

One of the first groups on campus to express interest in GIS was the Department of Electrical Engineering (EE). A professor in the department approached the libraries for help using GIS software to create a program for his class project. The objective was for students to create a comprehensive, linked network of cellular telecommunication towers across a developing country (or large province). Knowing that GIS had the mapping and spatial analysis capabilities to accomplish this goal, the library GIS staff worked with the professor to design a custom project for his students. (Figure 1) The teaching assistant for this course customized the software, ArcView, by adding tools that allowed one to place symbols representing radio towers on a country or province map. Designing this program with GIS software allowed the teaching assistant (TA) to include accurate spatial data representing man-made and natural features specific to each region. The customized project has been used for an assignment in the EE professor's course on rural telecommunication every fall quarter for the past 5 years. Each year, small adjustments are made to improve the application.

During one session each year, a GIS staff person from Branner Library gives a guest lecture introducing the fundamentals of GIS and ArcView software. This person then assists the TA with collecting and manipulating GIS data specific to each selected country or region into a project file. Most of these instructions are documented in a TA Manual that is used and updated by the TAs from year to year. Data on administrative districts, rivers, roads, populated areas, and digital elevation models are collected for the projects. These data are from ESRI Data CD-ROMs in the library, and from the Internet, the Digital Chart of the World[3] and GTOPO30[4] raster elevation data. If a project is created for a province rather than a whole country, the TA asks the staff for assistance with finding detailed population data. The TA seeks data and technical support from the library staff on behalf of his or her students, and this protocol is maintained throughout the duration of the class's project. That is to say, the TA fields most of the questions from the students and only consults GIS staff if he is unable to solve the problem. Sometimes students will want to include additional data layers to their projects, and the library staff will be consulted directly for assistance with their data search. More often the students accept the default project data exhibiting interest in completing the assignment, not developing a detailed project like one created for an individual's research.

Students work together in small groups on the library's four GIS workstations to complete their projects. Together they build a telecommunications network by placing towers in locations where each tower maintains a line of sight with its neighbors. Tower locations are selected by considering natural and man-made features such as rivers, roads, topography and towns. The output of the project consists of several maps as well as figures that contribute to an overall report assessing the cost of developing such a network. Students are allowed to store data on these computers for the duration of the fall quarter. This custom application of GIS gives the students an introduction to GIS and a chance to model the creation of a rural cellular telecommunication network. It gives students hands-on experience in a specific region, where before they were only given an oral description of the process of selecting tower locations. Students are able to create a rather sophisticated model without programming and in a fraction of the time that some professionals spend modeling the same network.

[3] Digital Chart of the World data available at *http://www.maproom.psu.edu/dcw/*, September 30, 2002
[4] GTOPO30 data available at *http://edcdaac.usgs.gov/gtopo30/gtopo30.html*, September 30, 2002

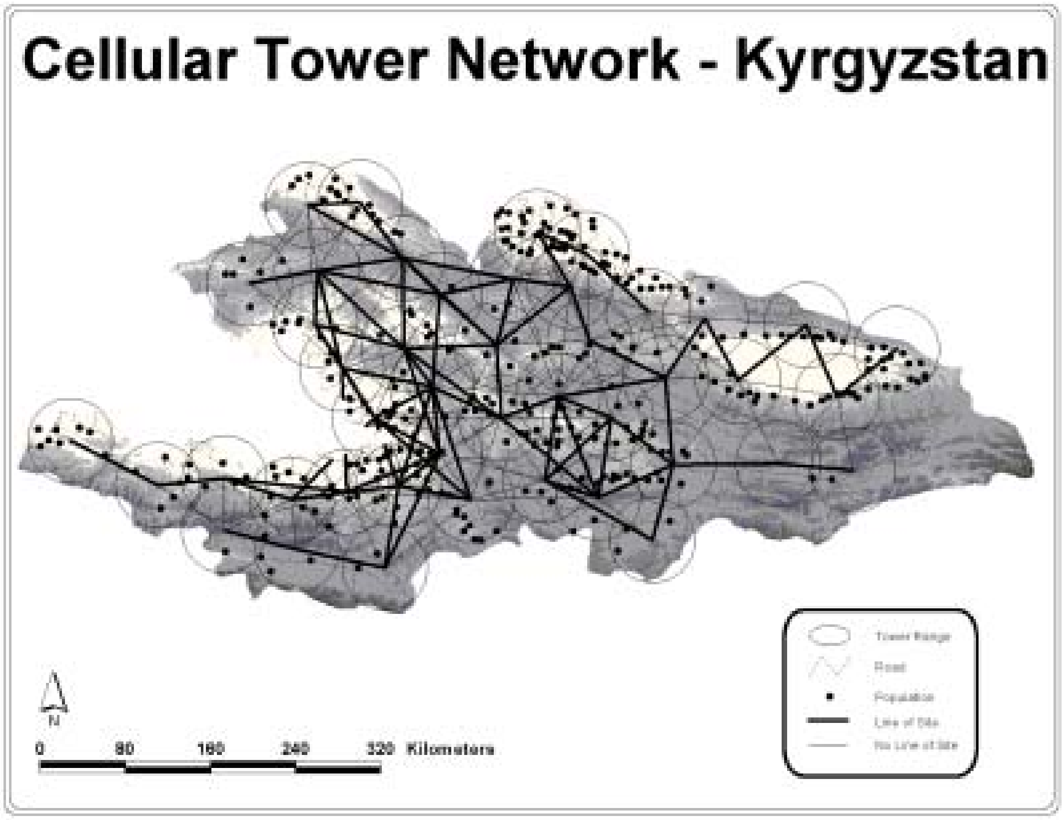

FIGURE 1: Map of a cellular telecommunications network for Kyrgyzstan completed by a student in Stanford's Electrical Engineering department.

Epidemiology Research Group

In the past few years, researchers from the Epidemiology Program and Department of Medicine at Stanford have begun using GIS. In January 2001, a group from the Stanford Center for Research in Disease Prevention, headed by Marilyn A. Winkleby, Ph.D., was awarded a 5-year grant from the National Institute of Environmental Health Sciences of the National Institutes of Health[5]. Their study was designed to assess the impact of neighborhood social and physical environments on mortality, particularly from cardiovascular disease. They began with the premise that neighborhoods may affect residents above and beyond their own individual characteristics by shaping social interaction patterns and influencing behaviors partly through the availability of goods and services.

From the start, the study was designed to include the use of GIS in order to extend their empirical analysis, to study spatial patterns that would allow for the generation of new

[5] This work was co-funded by the National Institute of Environmental Sciences and the National Heart, Lung, and Blood Institute: Grant 1 RO1 HL67731 to Dr. Winkleby.

hypotheses, and allow for more meaningful communication of findings to the four study communities. According to Dr. Winkleby, GIS would enhance the way they interpreted the data. Spatial relationships would be much clearer when seen visually. GIS would allow them to ask different questions and to perform spatial analysis, which could augment more traditional statistical analyses.

In April 2001, the GIS & Map Librarian and the GIS Manager held a GIS workshop focusing on health research applications. Participation by researchers from the Department of Medicine and students in Epidemiology was high. After attending the workshop, Dr. Winkleby's group set up an individual meeting to find out more about the resources in the library and to ask for help in defining the parameters of the GIS project. They had scientists on the project with strong statistical analysis and database creation skills but only introductory GIS skills. It became clear that because of the specificity of their information needs, most data would not be readily available to them through the library. They would have to create it themselves. They needed exact addresses for the goods and services in the neighborhoods that might influence health. They conceptualized these as either assets (e.g., churches, grocery stores, parks) or barriers (e.g., alcohol distributors, fast food chains, crime).

The research group started with a database from a large, completed study conducted from 1979-1990, by the Stanford Heart Disease Prevention Program. This study focused on four Northern California cities: Modesto, Monterey, Salinas, and San Luis Obispo. Over 8,500 randomly selected male and female participants aged 12-74 were surveyed and assessed for cardiovascular disease risk factors from 1979-1990. The survey included information on socioeconomic status (education, income, occupation), cardiovascular disease risk factors (smoking, physical inactivity, high blood pressure, high cholesterol, obesity, and high dietary fat consumption), and other psychosocial and health-related risk factors. The current research project is using data for participants aged 25-74 from this original study. The survey and risk factor data were matched to death records through the end of 2000 to assess mortality outcomes. The addresses of the participants were geocoded and linked to census, archival, and other data in order to assess the neighborhoods' social and physical environments. (Figure 2) Based upon a recent study in the American Journal of Public Health, an excellent geocoding firm was hired to handle the geocoding of the data (Krieger et al., 2001). The resulting map layers were verified to test their spatial accuracy.

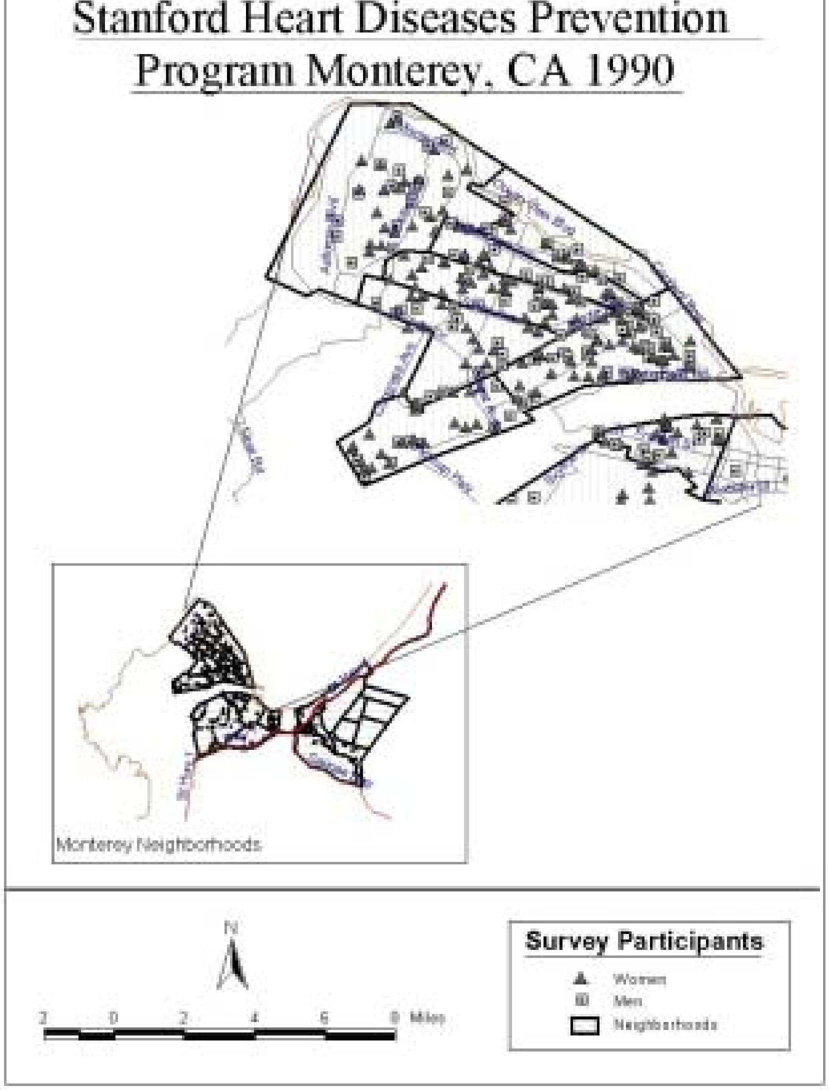

FIGURE 2: Distribution of male and female study participants within neighborhoods in Monterey, one of the four cities studied by the Stanford Center for Research in Disease Prevention

Recently completed, the first year of the study was heavily devoted to gathering data and creating the GIS using ArcView 3.2. The new neighborhood level information needed was so complex and detailed that the group explored many avenues to obtain it. The first task was to define "neighborhoods" in each city from the study period of 1979-1990. Although the research group wanted to use Census boundaries, they also wanted to approximate as closely as possible the real neighborhoods as experienced by the participants. City planners in each city met with the researchers to help define neighborhoods that were meaningful to community residents. Then, GIS Census boundary files were borrowed from Stanford's Green and Branner Libraries data collections as well as downloaded from the Census Web site. Eighty-three neighborhoods were built by aggregating Census Block Groups. The geocoded addresses of the study participants were then associated with a neighborhood and linked to the survey data.

U.S. Census statistical data for 1980 (from the Census Bureau) and 1990 (from Wessex in SAS[6] format) were retrieved. Census data were used to calculate variables measuring neighborhood-level socioeconomic status, residential segregation, residential stability, family and age structure, and urban/rural status. These data were then linked to the neighborhood polygons in the GIS. Census population centroids from the 1990s, downloaded from the Internet, were employed to easily represent the neighborhood population in further analyses. For example, the centroids were used to calculate an average distance that the neighborhood's population must travel to certain goods or services, such as a park, pizza parlor, or primary care physician. Joining the socioeconomic Census information to the geographic areas built the social environment for each neighborhood.

After creating the neighborhoods, addresses for the neighborhood assets and barriers needed to be obtained. These data were wide-ranging and often required persistence and creativity to locate. Assets included parks, educational institutions and libraries, open spaces, banks and credit unions, houses of worship, youth organizations, day care centers, grocers and fresh fruit vendors, and primary care medical facilities. Barriers included liquor stores, pawnbrokers, tobacco shops, fast food restaurants, bars, and gun shops. GIS specialists in the four cities helped the researchers find relevant local data and most offered use of the data without charge for the study. For example, parks were delineated with the help of GIS files, maps, and historical information provided by the city professionals. The majority of these sites were referenced by street address, and therefore required geocoding by the contracted firm for inclusion in the GIS. Once completed, the researchers drove by random sites to confirm the geocoded locations for quality control.

Telephone directories (white and yellow pages) often provided the best and most complete data for both assets and barriers, such as specific street addresses for stores, houses of worship, banks, and restaurants. These telephone directories were purchased from members of the community who came forward after ads were placed in local newspapers. Public libraries in Monterey and Salinas allowed the researchers to copy or scan addresses from telephone books at the library, but would not let the phone books circulate. Modesto telephone directories were purchased from Bell and Howell on microfiche. This part of the information-seeking process was the most laborious and time consuming. Data had to be manually entered into newly created spreadsheets and then geocoded in the GIS. The California School Directories held at Cubberly Education Library at Stanford provided the most accurate listings for schools and so were used in place of the phone books.

Alcohol licensing and accusation data (citations for alcohol-related violations such as sales of alcohol to minors) was available for every city from the California Department of Alcohol Beverage Control. The data included addresses of the establishment selling

[6] SAS Institute Inc. ® - A statistical analysis system

alcohol, type of liquor license, and the date of the license. Through the use of a "key," accusations, or the issuance of citations, were accurately matched to a specific establishment. The same level of detail was not attainable for tobacco sales. Neither the federal Bureau of Alcohol, Tobacco and Firearms nor the State agencies collect data on the retail sales of tobacco at a neighborhood level, nor is a license required to sell it.

Crime data proved to be very problematic to collect for the study period, 1979-1990. Uniform Crime Reports during the study period did not include addresses. On average, cities keep accurate crime data with locations and types of crimes for only 5 to 10 years. Police chiefs in the four cities were contacted and only one of the four, Salinas, had data that could be compiled at a neighborhood level that fell within the timeline of the study

Automobile collision statistics resulting in injury or death were collected from the National Highway Traffic Safety Administration from 1977 to the present. (The California Highway Patrol had this information from 1990 forward.) These data proved to be of limited value. In the study cities, few fatal crashes took place in any given year. In addition, street names where accidents occurred were recorded, but not the cross streets or addresses, making geocoding inaccurate.

Voting registration and participation records are currently being collected with the help of local County Clerk offices. The researchers are looking specifically for the rosters for each Presidential election, which will provide the party affiliation, address, and signature of voting members of the community. So far, San Luis Obispo County and Monterey County (which includes the cities of Monterey and Salinas) have agreed to release the data for the study.

GIS zoning map layers for industrial sections have been procured from the Planning Departments in each study area. It appears that maps from current years will be useable because zoning areas have remained stable over the last 25 years.

The process of collecting this information has absorbed the time of numerous scientists over the past year. It has called for using the resources of public and university libraries; GIS specialists; local, state and national agencies; and telephone books. It is the hope of the study's creators that this new detailed set of data will be of use to many other researchers who are interested in public health. With the data collection phase ending, they have hired a GIS specialist to expand the use of GIS in the project and to assist them with the next phase of multi-variate spatial analysis. The specialist has already been in contact with the library for software, data, and technical support. This research group exemplifies the variety of GIS needs that can be generated by one scientific project.

Conclusion

Libraries can and often do play a strong and influential role in the use of GIS on university campuses. By being a central point of contact for the acquisition of software and data, the library stays in touch with current research and the needs of the user community it serves. Outreach is critical in order to alert potential new users to the services available to them. Centralized, managed GIS support can save individuals and research teams a significant amount of time that would be spent obtaining site licenses, purchasing, organizing and distributing high quality data, and solving technical problems. Providing comprehensive Internet-based resources allows users to work independently in space and time by making the software and data available when the patron needs it, rather than when the library doors are open. GIS is an exciting, growing field and one in which the library can play a vital role throughout the campus.

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