GIS and Digital Geospatial Data
at TAMU Libraries
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Background of GIS in Libraries

GIS, geographical information systems, is an integrated system of computer hardware, software, data and trained people to work with the system. A GIS system is formed by geo-referenced layers of information. Researchers sort and select data in order to solve problems or draw inferences. GIS has been part of the mapping sciences since the 1960's. With the advances in computer technology in the 1980s and 1990s, it came to be popular as desktop technology. Libraries came to incorporate GIS data in the 1990s for two reasons. First, the US GPO decided to distribute the 1990 census and other data electronically. Secondly, the GIS software became relatively affordable. The ARL GIS Literacy project, for example, collaborated with software leader, ESRI, to introduce GIS software into libraries.

Sharing spatial data is what map libraries have done for many decades. The digital format, however, does raise many issues regarding library services. There is no set formula for GIS service in libraries. In the 1990s, numerous surveys and articles were written. Libraries struggled with service, hardware/software and data management issues related to GIS implementation. Foremost among these papers are ARL's Spec Kit 219 (*Transforming Libraries, Issues and Innovations in Geographic Information Systems*, 1997) and Spec Kit 238 (*The ARL Geographic Information Systems Literacy Project*, 1999). ARL conducted a survey of GIS in libraries early in 2005, the results of which are not yet available. *The Map Library in the New Millennium* (Parry and Perkins, 2001) contains a thorough discussion of the evolution of the map library collection into a digital environment. In the library community today, most large academic libraries include some amount of digital geospatial data in their collections. The library service levels vary widely, however, depending on the nature and priorities of the library system and campus community.

The role of librarians of geospatial data runs parallel to those of traditional materials. We must evaluate user needs, select, organize and make data ready for users. Public services are designed and offered. Beyond the traditional roles, the reference interviews and instruction will include geospatial literacy, data management and technical support.

There are two key concepts that librarians should understand regarding GIS in libraries. First, it is here to stay. There is no going back to a day without GIS data. The workforce who makes use of geospatial data is growing rapidly. The US Department of Labor has "set aside nearly $4.9 million to address the workforce needs of the geospatial technology

industry."[i] We should collect it, organize it, distribute it and teach geospatial literacy to our library constituents. Secondly, the software is getting easier to use. The industry leading ESRI product has evolved from a programming language to a windows environment. Other non-GIS focused software now contains mapping options, such as MS Excel and Microsoft's MapPoint. Both are rather low level mapping programs.

The recent evolution of the web based user interface brings the data selection and manipulation to a novice level. Our users are more techno perceptive and spatially literate. High schools have courses on GIS. Mapping technology is becoming widespread in many subject areas, including business, medicine, social sciences, as well as the traditional areas of the earth sciences.

In the face of changing needs, map libraries will evolve and services redefined. As we continue in the digital age, the map libraries will also become digital whether through digitizing projects or "born digital" data. Map libraries must extend their scope since many traditional map sources are now digital data products. Access to digital geospatial data is clearly vital to the global information community.

GIS in Academic Libraries

Libraries who are committed to GIS maintain various levels of services. Service levels differ as a reflection of library type, institutional mission, patron needs, budgetary constraints and staffing considerations. There are three levels of service to consider. At a basic level of service, a library will collect digital resources and make them available on their web page. A more sophisticated service unit will also provide basic reference help in locating datasets and limited assistance in using the software. The very sophisticated GIS services will also conduct training on the use of GIS software, will often manage a GIS lab or set of dedicated computers within a library lab, will scan items, generate metadata and create online exhibits. They may also collaborate on campus wide, local/regional or national research projects.

Environmental Scan - GIS at Texas A&M, 2005

GIS came to the TAMU Libraries in the mid-1990s. Recognizing the inevitable trend towards digital cartographic materials, the library hired a part-time lecturer, a doctoral student with GIS experience. During this lecturer's time with the library, datasets were acquired, hands on sessions were conducted, and materials were made available on the Map Room web page. This lecturer departed in 2003 and I was hired in 2004. As a librarian, I plan to create successful GIS services to benefit the university. The current mission as stated on our web page:

> "The Maps/GIS Unit furthers the mission of the TAMU Libraries by acquiring, managing and delivering geospatial information for members of the Texas A&M University community. Through personal service and expertise, we distribute local, state, national and international geospatial data in print and digital format."

At Texas A&M University, many departments and research centers make use of GIS data. Among the known heavy users are the Colleges of Geosciences, Agriculture and Life Sciences, Architecture, Engineering, and extension agencies, including TAES, TEES, TTI, the Real Estate Center, and the Texas Water Resources Institute and the Spatial Sciences Laboratory. Emerging users include segments of Liberal Arts (particularly History and Sociology), the Health Science Center and the Mays School of Business. Under the Administrative wing of campus is the Administrative GIS Office who maps the campus facilities and resources. We have requests for digital data from faculty, graduate students and researchers on a regular basis from many of these areas. Once our resources are advertised and available through the web, however, both the in-house and web use will surely increase.

There are numerous undergraduate and graduate courses in GIS, remote sensing and GPS (global positioning systems) taught predominately in the departments of Geography, Forest Science, Architecture and Civil Engineering. Students in the credit classes are generally well prepared to tackle their homework assignments and projects. They have access to the departmental labs that contain the GIS software, and generally complete the bulk of their assignments within their departments.

Just this year, the departments of Forest Science and Geography jointly created a new BS in Spatial Sciences. It brings together the multidisciplinary fields of scientific study through the application of technologies such as GIS, GPS and remote sensing. Up to this point, the study of GIS, GPS and remote sensing were an area of specialization or a minor (i.e. BS, Geography (GIS option); minor in Geoinformatics (Geography Dept.); graduate certificate in GIS or Remote Sensing (Forestry and Geography).

There are also non-credit workshops on campus, given by the Spatial Sciences Laboratory and the Land Information Systems (part of Wildlife and Fisheries and Texas Coop Extension). The campus software provider, ESRI, offers free online courses in GIS concepts and software techniques. Faculty, staff and students are eligible to take these free courses. They do, however, require access to the software (a $50 fee for students) and a user code, both easily obtained from the Software Evaluation and Licensing Library (SELL).

TAMU User Needs

Our users have not changed dramatically since the introduction of GIS services. The main difference is that for both GIS users and novices, there is an increase in requests for digital data and scanning of print materials. Most data needs are for local (city, campus and surrounding counties) and state data. Once the data is found, instruction is minimal. The difference is that now they often leave with digital data in addition to, or in place of printed materials.

There are three levels of users that can be considered. The beginners are interested in user-friendly mapping services. They want a site that is easy to explore and display. They are often satisfied with web based interactive web sites. The intermediate users have some hands-on experience with GIS software. They can manipulate, query and customize data. They may have some need for limited training or librarian assistance. The advanced user is skilled with many software packages and can input, store and analyze GIS data. They only come to the library for assistance finding or using problematic datafiles or when having technical problems. Extensive training is required for the librarian to support these highly skilled users' requests.

Among the less routine requests are from faculty and graduate students who do not have GIS experience, and request that we create a specialized map for them. It seems unfeasible to ask them to learn GIS. This is fundamentally "digital cartography" rather than GIS (a full-scale analytical project), but does require our staff be proficient with GIS software, datasets and general cartographic concepts. These large projects require many hours or days of work. We currently limit this service to graduate students who are completing their dissertation and faculty members publishing their work. We do not charge a fee for this service.

Public Services

Our public services should naturally tie in with user needs. [ii] While we continue filling requests for paper cartographic materials, requests for digital resources is increasing. We support class assignments through an in-house reserves system. Faculty stop in and select paper maps that are later used in their class assignments. There is not yet a call for digital resources for class assignments, although we have the capability to post items to our web, or through the library's digital reserves. Some of the class assignments require topographic maps or aerial photos of the local area, and some students request that we scan the material. Once the B/CS & TAMU data is scanned and made available on our web, the classes will have a direct link.

As with traditional reference services, geospatial resources are increasingly digital, with many resources found on the Internet. Patrons now turn to Google to discover answers to what we previously termed "ready reference." Patrons come to the building for the complex questions or for use of materials. Our patrons are comfortable with technology and are quick to adopt emerging technologies. Use of digital geospatial resources will increase in non-traditional fields. Our role will be to advise users on locating and using resources. We will have a larger counseling and materials selection role. We must be available to assist them in selection of datasets and in downloading the data. However, it is not in our larger role to teach users in-depth GIS or statistical analysis for the data. We must be able to refer them to ESRI and the campus courses for that.

There is a difference between true GIS (manipulation of geo-referenced data for analyses) and "digital cartography" (i.e. putting selected geospatial information together in a visual form). We can do the basic cartography with our current staffing. The analysis requires

significant training on the part of the researcher and we refer them to that training. It is worth noting here that other campuses have an office or group of graduate students who create maps for a fee. The university's Cartographic Services office closed some years ago. It is unclear if map creation services are available for the campus.

Our pilot projects creating maps is in process. We have created maps for four researchers (two graduate students and two teaching faculty) in the past six months. Each was quite different in topic, complexity and timing. We have not created any guidelines or limits for our services yet, beyond it being strictly for to supplement the authoring of graduate or faculty level dissertation/books/articles. We do not currently charge for this service, but will monitor and reevaluate this decision if demand increases.

Computing Facilities

GIS students typically have access to GIS software through their departmental labs (for those departments who are heavy users or offer courses in GIS). There is currently no GIS software in the open student computer labs on campus (SSC). The TAMU Libraries do not offer a computer lab or an information commons for students to access GIS. There is a gap between the course offerings and the long-term support for the students who only take a course in GIS, but are not part of a department with the software. Therefore, some students do not have access to the GIS software.

The current Map/GIS Room contains no open access GIS computers. Our public computer does not contain the GIS software, and the graduate student's computer is appropriate only for mediated service. Students can obtain a copy of the ESRI software through the SELL for a fee. Those unable to purchase the software have limited options. There have not yet been requests from students to use our computers for GIS projects, but as the needs will surely arise in the future, I will coordinate efforts between the libraries, the departments and the CIS to serve the students better.

Collections – Datasets

The key to high quality GIS service is the data. GIS is nothing without meaningful data. It must be complete, timely and from an authoritative source. Much of the typical data is government produced, distributed through the US GPO depository program. Commercial distributors also provide a wide range of GIS data and images. This is a form of "grey literature" since it is not packaged in the traditional book/journal format. Some of the data is a free download; some has a small fee, while other, specialized datasets can run in the hundreds and thousands of dollars.

The state's GIS Clearinghouse (TNRIS) produces and distributes a number of high quality datasets, most of which this library has purchased. They also provide datasets that can be downloaded on the fly, in a "just in time" selection process.

The cities of Bryan and College Station produce a number of datasets; many are on their city web pages. We link to their web pages and have access to what is largely current

data. The cities do not provide access to historical data on their web pages and the library is a natural option for long-term storage. I have already spoken with GIS staff in both Bryan and College Station about this concept, and they are interested in talking further. Whether this would sit on the Map/GIS server or under the Institutional Repository is up for discussion.

The campus community (faculty, graduate students, researchers, and the Administrative GIS office) also produces GIS datasets and maps. A small number of print maps have been donated to the library already. There is a natural role for the library to collect these materials, again perhaps under the umbrella of the Institutional Repository. We need to do more to collect geospatial materials produced on campus.

We can make a name for ourselves by putting up noteworthy digitized collections our website. Many libraries have put together wonderful web based exhibits from unique or popular items in their map collection. These projects are a very effective form of public service. An obvious starting point could be historical TAMU, College Station or Brazos county maps. These are heavily requested already. Collaboration with subject liaisons or Cushing could produce interesting thematic exhibits. Collaboration with other libraries on specific themes could also be quite rewarding. The possibilities are endless.

One aspect of purchased dataset collecting is the networking and licensing details. We must consider the networking and licensing implications at a very early stage in the purchase process. This will ensure the data can be accessed and used in a way that is most beneficial to the patron.

Collections – Metadata

The web serves a role as a collection organization or indexing tool. We must create metadata for our scanned collections. We can also serve as trainers or support for campus GIS users in their metadata creation. Metadata standards are highly developed in the GIS world.

There is a need among research libraries to coordinate large-scale scanning operations. Among MAGERT members at the recent Midwinter meeting in Boston, many were scanning materials, yet there did not seem to be any emphasis on submitting such projects to a larger organizing body. The Federal Geographic Data Committee (FGDC) develops procedures for discovery of digital geospatial data. Data elements are defined in the Content Standard for Digital Geospatial Metadata. Participants can make their collections of spatial information searchable and accessible on the Internet using free software developed by the FGDC. The FGDC's Geospatial Data Clearinghouse is a collection of over 250 spatial data servers. The servers have digital geographic data primarily for use in GIS, image-processing systems, and other modeling software. These data collections are searchable through a single interface based on metadata. See **http://fgdc.er.usgs.gov/index.html** for more information.

Libraries need to take advantage of the existing metadata structure and lead the efforts on their campus for complete metadata for locally created data sets.

Hardware and Software

Many academic libraries choose ESRI products as their primary software. We are no different. Our library (and many campus users) uses ESRI's ArcGIS 9, which is the latest version. It includes the mapping software, and associated metadata and database and cartographic analysis modules.

We have also purchased additional extensions for our GANT in order for the creation of sophisticated projects using ESRI's ArcIMS. ArcIMS allows for web-based delivery of dynamic, customized maps. Our city governments and many corporate web sites utilize this software for their web projects.

The Maps/GIS Room contains a large format scanner and plotter. These support our GIS efforts and are essential for our paper-based map services as well. However, we do not allow self-service. We feel compelled to perform this service using our trained staff due to the complexity and expense of the equipment. Even with our self-imposed use limits, we have had to call upon our systems staff a handful of times for equipment repair support over the past six months. I should also add that only a few locations exist on campus with this advanced equipment. Our users come primarily from geology, geography and architecture. We initiated fees for plotting and scanning services this year and patrons have adjusted without complaint.

Web based interactive mapping

The interactive mapping web sites are becoming widespread. They provide a format for querying and building customized maps. Some standard reference tools, such as the National Atlas, are now served up digitally in the form of an interactive mapping web site. The American FactFinder (Census) and the EnviroMapper (EPA) are both examples of powerful tools from the federal government. Users are already familiar with the interactive mapping interface, many having used Expedia or other travel web sites for personal use.

This web development supports our public service efforts. The web is 24/7 while our service hours are not. Our collections include purchased datasets and locally scanned aerial photos, which we are in the process of putting into the CMS for display on our web page. In addition, an expensive set of topographic maps of the world (that has languished for a few years unused) is currently being loaded into an ArcIMS system that provides for manipulation in an interactive web map system located on our web page.

Both our local city governments, mentioned above, have web based interactive mapping sites that are extremely informative for the local population as well as researchers.

All public service areas can easily serve web based interactive mapping for library patrons. Librarians and staff need to become familiar with these resources in the same way that they are familiar with the layout and content of indexes and databases. I foresee an increase in this method of delivering geospatial data – very user friendly, free, quick and easy.

Outreach

Like other areas of librarianship, there is a role of outreach for library services of GIS. The library's web presence is a meaningful way to reach campus users. Presenting our datasets and services on our web page will continue to bring people into the Map/GIS Room. Expanding our web presence to include unique collections, scanned items, local data and our purchased holdings, will also increase our users' understanding of our resources and services. We are in the midst of adding these to our web now.

Potential users can also be reached through both traditional instruction sessions and specialized Map/GIS sessions. In a traditional session, the instructor could introduce geospatial literacy, review general concepts about GIS and share our handout. I can also give specific instruction sessions to show use of GIS in research and the resources available to users in many subject areas.

There is also a role for the librarian as liaison among campus and community groups. Getting out of the library to attend a departmental open house, career fairs, or student meetings are effective and have already begun. It is necessary for the library to have representation in such a group to support a framework for licensing and enable purchasing of data across administrative boundaries.

Building support networks with staff at the Spatial Sciences Laboratory and the Land Information group has also begun. These two offices provide training. They also manage GIS data and have already been a great help in building our GIS services in the past six months.

The local community hosts a monthly GIS user group meeting. GIS users from the city and county governments, police force, school districts, etc. discuss their projects and programs. These are producers of local GIS data. Very few TAMU faculty and students attend. I have attended this meeting regularly for a year now. I hope that this level of networking will allow for long-term cooperation and sharing of data between the library and the local GIS community.

The library can serve as a gathering place for GIS events, such as the national GIS Day, or GIS user group meetings. There is no such campus user group organized at this time, which is unfortunate. The library facility is neutral territory to the sometimes-political academic landscape. The SSL has mentioned some interest in hosting a GIS Day later this year. We will look forward to collaborating with them to present this event for campus.

It is also important to begin collaboration among existing digitally oriented campus groups, such as the Academy for Advanced Telecommunication & Learning Technologies and the TAMU Institutional Repository.

Outreach should also extend to other academic libraries, particularly within Texas, for possible joint scanning or service projects. California, for example, has a very well organized network of map librarians from UC and Stanford.[iii] They meet regularly and have written cooperative agreements for collection development and lending. Texas would do well to model their network.

Inreach – TAMU Librarians and Staff

Our librarians and staff can provide a great deal of geospatial service without a moment of formal GIS training. Geospatial literacy is part of a well-rounded information base on both sides of the reference desk. Librarians and staff need to know that plenty of information is on the internet that is accessible and usable without formal training, i.e. the interactive web mapping sites. They also need to understand that these interactive mapping web sites are intended for novice users. As service providers, those outside the Map/GIS Room can point to these sites in their subject area and navigate through them. It is my goal in the coming months to provide in-house training on a wide selection of interactive mapping web sites. I plan to give presentations on resources in many subject areas for the main campus and west campus staff.

Our selectors also should consider themselves partners in purchasing GIS datasets in their subject area. Some can be expensive, however, we can consider finding ways to pool funds when quality datasets become available for purchase.

Subject liaisons must be aware of grant opportunities and build upon existing partnerships for possible funding opportunities. There is a great deal of money in digital projects, especially historical preservation. Joint efforts can be both professionally and financially rewarding.

Inreach – Systems Staff

Effective teamwork with our Systems staff is extremely critical. They are key players for our technical support at many levels, including our authorizations on the server, software loading and even problems with our plotter and scanner. Even though they do not have experience with GIS software, the systems staff has put in a great effort to understand its particulars, and are very responsive with our many requests. They, and we, are learning as we go, and there is good will in both directions. They have learned that our requests are often complex and technically extremely challenging. Evidence of such crucial teamwork is our sharing of server space (lib-sanfront) for our maps and images presented on our webpage. Some libraries do have a separate server for their GIS operations. Sharing of the server adds a layer of administrative and technical difficulty, but we managing to work within the existing structure. We do appreciate the systems staff support in building our program.

Map/GIS staffing and skill levels

The Maps/GIS librarian and staff must know how to locate and download datasets. During the reference interview, we must think in terms of digital as well as print sources. We must understand the source of data, discern the quality of data, and have creative problem solving skills.

The librarian's key role is in the designing and managing of services. Once users' needs are determined, the librarian must prioritize, plan and gather resources for projects. The librarian must select and promote our information resources. One way is to make our resources prominently available on the web, and bring the new information to awareness of the teaching faculty.

Our graduate student must have strong technical expertise with ESRI products, cartographic principles and web creation. We rely on our GANT to interact with systems on technical details for our networking and server based projects. Our GANT is also a key player on expanding our web presence. His experience with ArcIMS and servers is allowing us to serve up large files on our web page. These projects are typical of many ARL libraries. It is fair to say that we are now in the process of catching up to the leaders in the library community. Our GANT also has a role in the creation of customized maps for patrons. He has already created maps for a handful of graduate students and professors who are all very appreciative.

Our undergraduate student workers can also play a meaningful role with the GIS services. We must hire more who have completed basic, if not advanced, GIS courses. They can work on scanning, georeferencing or general tasks that support our GIS and web projects. One day in the future, if the library creates an information commons area, the trained Map/GIS students can support the GIS technology there also. Depending on their experience, they may also be able to create simple customized maps for patrons.

One MAGERT member acknowledged that at his library, there were more staff devoted to digital geospatial data than where for print maps. It is clear that the geospatial community has evolved to heavy users of digital data, and the library must have highly trained employees at all levels in this area.

Need for continuing education/professional development

Training for Maps/GIS staff is essential and on going, and must include basic cartography, use of software as well as the content and selection of numeric/statistical data. ESRI provides free online courses that both Rick and I have already begun taking. We should continue to attend library hosted or GIS user conferences or other workshops to further our training expand our networking opportunities. ALA's MAGERT (Map and Geography Round Table) regularly hosts programs to support GIS in libraries, and TLA recently held a preconference workshop that I attended.

In a larger sense, there is a lack of library school courses for both traditional mapping and GIS librarianship. Those hired in either area often require some on the job training. We should consider hosting a library school student as an intern. Library schools could collaborate with geography for a joint GIS/MLIS degree. That would bring qualified GIS experts into librarianship. Additionally, libraries could hire GIS techs and support their attendance at library school.

Need for continuing assessment/adjustment of service level

As with any emerging service, there is a need to monitor and adjust services. Campus needs will change, the software and hardware will continue to evolve, as will the library. As we promote the use of the geospatial resources, our users will respond with increasing expectations. Use of surveys along with careful monitoring of services will permit our GIS and cartographic services to meet and perhaps often exceed expectations of users.

Conclusion

The worlds of print and digital cartographic resources are quickly merging. A well rounded Map and GIS librarian must be aware of print, digital and interactive web resources. Selection must be in all formats, and access provided in both physical and virtual format. Extending our web presence and giving training sessions to both library employees and library patrons will ensure the relevance of the service area to the campus community. Geospatial resources are an exciting material to work with. Awareness of these materials and knowledge of their application is essential to serve the ever-expanding global community.

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[i] US Dept. of Labor, Employment & Training Administration. Local Solutions with National Applications to Address Geospatial Technology Industry Workforce Needs (www.doleta.gov/BRG/Indprof/Geospatial.cfm)

[ii] RUSA, Guidelines for Information Services, Revised 2000.

[iii] UC/Stanford Map Libraries Group (http://library.ucsc.edu/maps/ucsmg/)