

GIS for Hire: The Call for Standardization

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Abstract: When choosing a doctor, diplomas and hospital affiliations are reliable indications of competence. The eminent medical practitioner is easily distinguished from the quack on the street. But how do you judge a good GIS provider? What are the criteria? Is a computer programming expert preferable to a cartography major? Does a geographer outpace them both? Is experience more important than certifications and degrees? When did “caveat emptor” become the operative phrase for those soliciting GIS services? This paper explores the issues of liability, standardization and credibility facing both GIS providers and their prospective clients as the GIS industry proliferates.

A New Technology: The field of Geographic Information System (GIS) technology is relatively new. Unlike law and medicine, which have been around in one form or another for hundreds of years, GIS has only been around for a few short decades. Many people and organizations currently at the forefront of this technology learned its ways and developed its applications as they went. In doing so, they largely established what GIS technology is today.

The United States Department of Labor officially recognized GIS as a profession in 1993, and listed the practitioner at that time as a GIS Specialist or GIS Analyst. According to the associated definition of the field, a GIS practitioner will display expertise in four key areas:

- ◆ Information technology, including database design and management
- ◆ Geography and cartography, including map design and spatial relationships
- ◆ GIS technology, including software and data conversion
- ◆ Other essential skills, including mathematics, presentation and training

These are very broad areas of expertise, and it is likely that GIS professionals will only possess them in varying degrees. Which of these skills should be most important from a client’s standpoint? How can someone outside the mapping industry distinguish a reputable GIS provider from one with questionable credentials?

Judging Qualifications: If a person were checking the references of an individual in the medical profession as opposed to an individual in the GIS profession, the process would be much easier. The verification of an M.D. or similar degree would be the first step in establishing professional competence. In addition, there are numerous websites available that will display a medical practitioner’s hospital affiliations or background. For a lawyer, engineer, surveyor or other licensed professional, similar checks and balances are also in place.

With the exception of the American Society for Photogrammetry and Remote Sensing (ASPRS) website, which lists a small number of GIS or related specialists that have received ASPRS certification, there does not seem to be any definitive listing of GIS professionals on the Internet. There are a number of well-known mapping organizations that sponsor online membership lists, which would assist in determining some level of professional involvement on the part of a GIS practitioner. However, it is often necessary to be a member oneself in order to access the membership list. The ESRI partnership list, which is accessible to anyone visiting the website, may provide some initial guidance when searching for GIS service providers. But even this list cannot be considered all-inclusive.

It could be argued that GIS is as much an art form as a science, which makes judging the end GIS product and its creator largely a matter of opinion. Just as no two photographers are likely to photograph identical landscapes in exactly the same perspective, no two GIS professionals are likely to create entirely identical end products from the same datasets. However, there should be certain fundamental similarities of content, even where there are differences of design, layout or color scheme.

An Accurate Foundation: The use of GIS technology has streamlined the process of information retrieval, analysis and management for a variety of professions. Environmental organizations utilize GIS to determine the location of Brownfields or contaminated sites, wetlands, open space, flood zones and conservation districts. Public works departments utilize GIS for infrastructure mapping. Planning and development groups utilize GIS to manage Urban Enterprise Zones, Empowerment Zones, Neighborhood Preservation Programs, HOPE VI Programs, historic districts, redevelopment zones, zoning designations and Main Street Programs. Tax Assessors utilize GIS to track parcel and land usage. Law enforcement agencies utilize GIS to track criminal activity and verify Drug Free and Drunk Driving Free School Zones. Fire and ambulance personnel utilize GIS for emergency management and address location purposes. Public health officials utilize GIS to track the spread of disease. The retail sector utilizes GIS to study buying and selling trends. But the one thing all GIS applications have in common is mapping.

Surveys form the base map foundation for a large percentage of GIS projects. The layers of geographic information ultimately applied to the base map should be georeferenced to available GIS resource data, aerial photography and the State Plane Coordinate System to ensure an accurate fit. Without these measures, the functionality of a GIS database will be severely diminished.

Both the professional engineering and professional land surveying boards in the State of New Jersey are discussing the issue of GIS certification with great interest. There is currently GIS coursework available within the framework of both disciplines, but not as a specialty within either profession. Since surveys are integral to GIS mapping work, the survey profession appears to be taking the lead. In many states, it is now required that a licensed surveyor be directly involved in certain aspects of GIS projects, particularly tax parcel work. In fact, most existing programs for qualification and/or certification of

individuals in the GIS profession are found exclusively in the land surveyor's domain in many countries around the world.

But just as a photograph is only a likeness of a person or location, a GIS map is only a likeness of an original survey. The data in a GIS database is for reference purposes only, and although based on land surveys and related mapping, must not be construed as an official or legally binding document in the same sense. GIS is a tool that is meant to utilize data from many different sources, including surveys, but it is not meant as a replacement for any of them. Proper use of disclaimers that reference the intended use of the GIS mapping data, as well as its source, should always be included on any GIS mapping product to preclude misuse and/or liability issues. Accurate metadata is also important, and needs to be collected and documented accordingly.

Education Versus Experience: College students and recent graduates now have the benefit of GIS coursework, where many respected GIS professionals had to learn the technology as it developed. There are educational facilities across the country currently offering certificates or degrees in some form of GIS technology. For a prospective employer or a prospective client, this type of GIS credential could be a key indicator of qualifications or expertise.

When looking side-by-side at the resumés of a seasoned GIS practitioner and a newly certified GIS graduate, the seasoned practitioner may initially outpace the graduate by virtue of experience. A long list of projects, references and accomplishments is a convincing recommendation of professional competence. However, once the new graduate has been in the workforce for a few years, the balance will likely shift. The combination of certification with even a limited amount of on-the-job experience will be difficult for a non-certified professional to compete with.

Even when ranking the qualifications of two GIS graduates, the determination of competence may be difficult. There is currently no accreditation of GIS educational programs, as there is for other professional studies, and no single authority overseeing their quality or content. As far back as the 1988-89 school year, the National Center for Geographic Information and Analysis (NCGIA) established a GIS Core Curriculum as a guide for educational facilities interested in teaching GIS technology. Recommended coursework included global positioning, map projections, spatial relationships, computing systems, types of data, cartographic design, and database planning. Coursework in various specialty GIS areas, such as cadastral applications, resource management, and land use and planning, was also suggested. The variations on this framework now in use by educational facilities across the country are as boundless as GIS applications themselves. Some academic programs place the most emphasis on computer sciences, others on earth sciences. A graduating student may receive a GIS certificate, a GIS Technician Certificate, a Professional Certificate in GIS, a GIS Programmers Certificate, a Certificate in Geomatics, a Degree in Geographic Science, a Graduate Certificate in GIS, or a Masters of Science in GIS, depending on the educational facility or field of study chosen.

Many of today's certificate programs are also geared toward the working GIS professional. Evening classes are often available, and long distance learning via the Internet has become increasingly popular. Some programs will allow veteran GIS professionals to substitute work experience for pre-requisite coursework or credit hours, thus reducing their time in the classroom. However, many of these same professionals have family obligations or work responsibilities that make returning to school a difficult proposition. In addition, the cost of the coursework is often equally prohibitive. But in an increasingly competitive marketplace, even a GIS professional with many years of experience may eventually require some type of official document attesting to his or her qualifications. The quest for a new client, a promotion, or even a new job may suddenly depend on it.

There are additional credentials available outside the realm of a regular classroom. Seminars, workshops and training programs are offered regularly by local and national GIS organizations, including ESRI. The accessibility of this type of training, whether through classroom study, user groups or webcasts, raises some interesting questions:

- A.) Does participation in one or two training programs in the fundamentals of GIS applications qualify an otherwise untrained individual as a GIS professional?
- B.) Can GIS professionals without formal certification augment their experience with this type of training alone and still remain competitive in the industry?
- C.) If a GIS professional already has a certificate or degree in GIS technology, is this type of additional coursework even necessary?

Definitive Guidelines: Although there is no national standard for GIS certification and practice in the United States, the International Association of Assessing Officers (IAAO) and the American Society for Photogrammetry and Remote Sensing (ASPRS) offer their own programs for professional certification in the mapping sciences. The Urban and Regional Information Systems Association (URISA) is developing a certification program as well.

The IAAO has several types of certification available, mostly within the property appraisal or tax mapping professions. The Cadastral Mapping Specialist designation is recommended for IAAO members involved in map production for property appraisal and assessment purposes. A candidate for this certification must be an IAAO member in good standing, have a high school or equivalency diploma, have at least three years of experience in cadastral mapping, and have credit for IAAO or equivalent coursework in property appraisal, mapping techniques, advanced mapping, Cadastral Mapping/GIS, and standards of practice and professional ethics. The candidate must then pass an eight-hour exam on Cadastral Mapping, followed by a four-hour Master Examination. There is an initial application fee involved, as well as a yearly maintenance fee thereafter for anyone seeking and receiving certification. Members are listed on the website, but the list is accessible only to other members.

The ASPRS offers certification for photogrammetrists, as well as two types of mapping scientists. The program is open to members and non-members. An individual can

become a Certified Mapping Scientist specializing in Remote Sensing, or a Certified Mapping Scientist specializing in GIS/LIS. Applicants must pass a peer review of experience and training, followed by a written examination for the specialty chosen. For the designation of Certified Mapping Scientist in GIS/LIS, the applicant must also have three years of experience in mapping science or photogrammetry in a position of responsibility, along with three years of professional experience in Geographic or Land Information Systems. At least four persons who are holding, or have held, responsible positions in the mapping sciences and GIS or LIS areas, and have firsthand knowledge of the applicant's professional and personal qualifications, must provide references. The applicant must declare compliance with the ASPRS Code of Ethics and successfully complete a written examination. Part of the application includes a series of essay-style questions regarding the applicant's contributions to the GIS/LIS field, use of GIS/LIS on the job, and means of keeping current in GIS/LIS technology.

The ASPRS also charges an initial application fee for certification, and recertification is required every five years in order to remain on the ASPRS "active" list. For recertification, an applicant must provide four recent references, along with verification of continued professional involvement in the mapping sciences for the last five years. Involvement may include attendance of workshops or conferences, presentation or publication of papers, and providing mapping services in a professional capacity. An additional fee is also involved. The ASPRS website offers an online searchable list of all active Certified Professionals in each category, which is accessible even to non-members. An embossing seal and rubberstamp containing a certified professional's name and certification number is also available from the ASPRS, similar to the professional seals used by engineers, land surveyors and architects. Applying this type of seal to a GIS mapping product may one day serve to lend the same credence to a map that an engineer's seal currently provides to a set of engineering plans.

The ASPRS has a variety of procedures in place to maintain the high industry standards contained within its Code of Ethics. An Evaluation Committee is responsible for approving or rejecting all applications for certification or recertification. A Professional Practice Division monitors and develops policy guidelines. The Professional Conduct Committee investigates any allegations or complaints involving practicing photogrammetrists and mapping scientists, and recommends appropriate action to the Board of Directors. The Board of Directors has the authority to revoke an individual's certification or recertification if the individual has violated or shown flagrant disregard for the ASPRS Code of Ethics. Even though ASPRS certification is purely voluntary, the threat of revocation for professional misconduct sends a powerful message to certified GIS professionals as well as those seeking their services.

The URISA Certification Program for GIS Professionals is still under development at this time. It will be administered through the GIS Certification Institute (GISCI) affiliated with URISA. Although a pilot program is currently underway for pre-selected individuals, the URISA/GISCI Certification Program will not be available to the general public until late 2003. The program is a point-based system that is documented and calculated by the individual seeking certification. A specified number of points will be

required in the categories of educational achievement, professional experience and professional contributions. The most points are required in the professional experience category. It is unknown at this time what fee will be involved with this certification. No examination will be required, and the certification process will be open to members and non-members equally. Recertification, through continuing professional participation, education and achievement, will be necessary every five years in order to remain current. There is presently no information regarding the availability of online access to any future listing of individuals certified through this program.

The American Congress on Surveying and Mapping (ACSM) considered a GIS certification program in the past, but has not proceeded since the URISA program was conceived. The ACSM does offer certification programs for surveying technicians and hydrographers, which are based on credentials and examinations.

Comparing the Programs: The IAAO designation of Cadastral Mapping Specialist involves experience, coursework and examinations. Although knowledge of GIS is included in the program, the requisite coursework leans heavily toward property appraisal and assessment. This certification would seem most beneficial to professionals specializing in tax mapping and related services. In the civil engineering field, this type of project forms a large portion of the annual mapping revenue. Cadastral mapping also provides an excellent base map for municipal GIS applications, such as 911 Emergency Address Maps and Utility Infrastructure Maps, where accurate address or tax parcel location is key. In addition, there are other municipal GIS applications, such as color-coded Land Use or Wetlands Maps, where a tax parcel overlay provides needed points of reference.

Not all tax maps are in digital format. Many smaller municipalities in particular cannot afford to have their existing tax maps digitized. Updating or revising a manually generated linen or mylar tax map that was inked by hand requires an entirely different type of expertise than updating a digital tax map. Many drafting schools no longer teach the board drafting skills that are required for manual tax map work, yet these skills can be just as essential to cadastral mapping as computer or GIS knowledge. And although cadastral mapping in the civil engineering field requires knowledge of property deeds and plans, it is not altogether necessary to understand property appraisal or valuation, which is a requirement of the Cadastral Mapping Specialist designation. Since GIS technology is not widely accepted for the generation of State approved tax maps, but serves more as an adjunct to cadastral mapping services, the Cadastral Mapping Specialist designation appears very limited, particularly from a client's perspective.

The ASPRS designation of Certified Mapping Scientist in GIS/LIS seems much better suited to a GIS professional seeking general proof of GIS experience and qualifications. Like the IAAO program, the ASPRS certification involves experience and examinations. It also requires references from other professionals, and adherence to a strict Code of Ethics. Recertification every five years requires proof of continued professional involvement in the mapping sciences and efforts to keep skills current. A Certified Mapping Scientist in good standing will be listed on the ASPRS website, which is

accessible to any prospective client looking for verification of credentials. The existence of a Professional Practice Division to monitor and develop policy guidelines, coupled with a Professional Conduct Committee to uphold them, implies that only the most highly skilled and upstanding professionals will be able to achieve and maintain the ASPRS certification.

The burgeoning URISA Certification Program for GIS Professionals closely follows the ASPRS program, with the exception of an examination. Educational and professional credentials in GIS technology are required. Once certified, GIS professionals will need to seek recertification every five years by proving continued educational and professional accomplishments in the GIS field. The GIS Certification Institute, which will oversee the URISA program, will utilize the URISA Code of Ethics to encourage high professional and ethical standards. However, it is uncertain at this time how any complaints of misconduct against certified GIS professionals will be handled within this program.

Conclusions: It seems inevitable that some type of GIS certification will be necessary in order to remain competitive within this highly technical and continually evolving profession. The general public, including both clients and employers, requires proof of competency before making any decision. Since there does not seem to be a truly definitive GIS certification program on a national level, where a prospective client could access an all-inclusive list of certified GIS practitioners in every specialty, a more regional approach may be needed. It may ultimately be necessary to form State licensing boards to license and oversee GIS professionals, similar to the boards currently in place to license and oversee professionals ranging from accountants to plumbers to veterinarians. This would allow each state to establish and regulate the use and practice of GIS technology within the confines of local mapping laws. It would also provide a centralized and definitive means for GIS clients to evaluate practitioners or report misconduct. It would be unfortunate to allow another profession with licensing standards already in place, such as land surveyors or engineers, to absorb the GIS profession as its own sub-profession and thereby confine its practice accordingly.

GIS deserves to be a profession in its own right, with standards and practices established by those who know it best. Whether through certification or licensure, the following goals would serve to solidify the GIS profession and lend it unassailable credence:

- ◆ Establish a core level of competency that must be achieved by all GIS professionals, regardless of specialty. At the very least, an individual should have some level of formal training in GIS software and applications, geography, cartography and mathematics. Future accreditation of GIS educational programs to this end would also be helpful.
- ◆ A general examination, such as might be expected following college coursework in GIS fundamentals, should be mandated prior to any type of certification, even for established professionals. Although GIS applications vary widely, there are basic fundamentals that are common to all.
- ◆ Allow practical experience and knowledge to reduce or eliminate more of the coursework involved in college-sponsored GIS certificate programs. If an individual

with a proven job record and established list of GIS projects is desirous of obtaining a college-sponsored GIS certificate to further his or her career, all but the highest level of coursework is likely to be redundant. Allowing an experienced professional to simply take the exam associated with completing the necessary coursework, rather than having to sit through the actual classes at the expense of work or family, would encourage more professionals to seek these credentials, thus adding to the integrity of the profession. This is similar to the process home-schooled students have used to establish and document the knowledge they have obtained outside the traditional classroom.

- ◆ Establish a centralized and accessible listing of GIS professionals, whether by specialty, region or state, to serve as guidance for prospective clients or employers.
- ◆ Create a GIS Board, or similar overseeing body, to establish and maintain professional standards and ethics. This could be accomplished at a national, State or regional level, and would consist of reputable GIS professionals and educators. Any questions, accolades or complaints regarding the GIS practitioners under each Board's jurisdiction would be directed to and handled at that level.
- ◆ Establish guidelines for the presentation of data in the GIS realm. An individual utilizing a GIS database or referencing a GIS map should be made fully aware of the extent or limitation of its uses. This may alleviate the potential for misunderstanding or misrepresentation that will ultimately reflect poorly on the GIS profession overall.

Although many of these precepts are currently available through one GIS organization or another, further standardization is needed to make certification equally available to all GIS professionals, and to demonstrate the profession's willingness to govern and discipline its members. It is only by gaining the public's trust that GIS practitioners can achieve the professional growth, acknowledgment and respect they have been striving for all along.

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