The Significance of Public Safety for GIS Professional Licensing and Certification

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Abstract: *What is the relevance of public safety concerns for geographic information system (GIS) certification? How should professionals and instructors incorporate these concerns in education? The importance of public safety is developed in this article through the examination of two case studies of licensing that engage the political, philosophical, and scientific dimensions of licensing and certification. While these case studies deal with licensing, they point to a critical question for GIS certification: Is there a test that assures that GIS certification will fulfill public safety concerns? The many issues impacting public safety indicate the impossibility of a single test. GIS professional certification must reflect the broad range of public safety concerns. Despite the difficulties in establishing criteria that ensure public safety, discussions surrounding certification help articulate a core body of knowledge in GIS and GIScience, identify standards of practice, and promote research in this area. In terms of education, consideration of public safety issues should become part of curricula preparing individuals for future careers. A fundamental awareness of public safety issues can and should be appropriately anchored in GIScience education.*

Introduction

Public safety concerns connected to geographic information quality and reliability are not new (Burley 1993, Obermeyer 1993), but have recently led to an increased concern with the methods and practices of geographic information system (GIS) professionals and the credentials of those involved (Obermeyer and Onsrud 1997). Certification and licensing appear to offer a solution to these concerns, while also contributing to defining an amorphous field. This contribution includes helping resolve the difficulties that employers have in identifying suitable candidates (Huxold 2000) and supporting the professionalization of GIS (Somers 2000). In the United States, states and counties address important public safety concerns through certification of surveyors-in-training and licensing or registering of surveyors. Other countries address these issues through similar approaches. However, the breadth of GIS use takes many activities outside of this regulated area. The surveying profession in the U.S. recently has taken issue with the public safety issues inherent in untrained and unqualified people collecting original measurements used in determining the boundary or the location of fixed works (Joffe 2001). Many questions are being asked about certification proposals for GIS (Somers 2002). This article addresses the key dimension of public safety as a criteria for professional certification or licensing.

While the term "public safety" is popularly associated with public health concerns, fire, emergency medical services, and disaster planning, it is a key concern for the structures designed and built by architects and engineers that could possibly endanger members of society. For this reason, public safety is the prime reason for licensing programs that protect the public from individuals apparently claiming sufficient credentials and abilities (Allen et al. 2000).

Ostensible public safety concerns, however, may mask economic interests and attempts of an elite group to assert political control of a profession. As a result, licensing and certification can demonstrate contradictory purposes. Consider the examples of hair stylists and cooks. Hair stylists are licensed in most areas. While this activity evidences some degree of public safety concern, is this concern sufficient to require licensing? The comparatively limited public contact and corresponding low safety risk to the public clearly speak against the cost and complexity of certification or licensing, yet even poorly paid hair stylists must pay for licensing. In contrast, consider the licensing of cooks with much more public contact. Cooks are generally not licensed, although many have voluntary professional or apprenticeship certificates. However, many cases of disease spread by cooks have endangered public safety. The famous case of "Typhoid Mary" who worked as a cook at several homes and restaurants infecting hundreds of people with typhoid has become part of popular knowledge. In spite of numerous deaths, her career as a cook ended only when she was forcibly quarantined to an island in New York Harbor. The examples of licensing in the first case and the lack of licensing in the second reflect the complex interactions between public safety and professional motivations of relevant professional organizations.

Even though there are contexts in GIS with no immediate public safety implications (e.g., ecological habitat mapping), public safety has some relevance in all discussions surrounding GIS certification. Clearly, in a few areas using GIS—emergency management services, public health, fire protection, civil engineering, some engineering applications—public safety is an issue for nearly every activity (Amdahl 2001). Practitioners in these domains recognize public safety issues. Currently, they could be readily licensed, certified, bonded, and/or insured. However, public safety concerns are much broader. A homeowner with some experience could use a GIS to determine where to put a new well. A planner could use a GIS to evaluate building conditions and code violations and call for demolition of substandard housing units. The well digging could hit an underground cable or gas line, and the destruction of affordable housing could put people on the street or in overcrowded shelters. The range of public safety issues is theoretically infinite. As a result, GIS professional certification has been proposed by some as a viable response to these concerns.

It is important to acknowledge that a number of reasons beyond public safety concerns are offered in support of GIS certification. These include the need to assist employers in assessing a job candidate's knowledge, the demand by practitioners for a way to demonstrate their hard-earned skills and knowledge, and the need to help those who wish to become GIS professionals design appropriate education and experience pathways (Huxold 2000). As well, it is useful to note that discussions about other forms of certification are current in the GIS context. In addition to the certification and licensing of individuals, software and data certification offer alternative or complementary approaches to ensuring public safety. While these are intriguing possible solutions to the issue, they involve fundamental issues outside of the scope of this discussion. This article focuses on the public safety concerns as a crucial aspect of GIS certification and points out the relevance of taking up these issues in GIScience education and research.

Certification and Licensing: Key Differences

Because the terms "certification" and "licensing" are widely used, and confused, it is important to begin by examining their respective definitions. Legal writing on the subject makes an important distinction. Certification shows that a standard or level of quality has been met. For example, the Good Housekeeping Seal of Approval is a certification that attests a product meets industry-set criteria. Certificates can be awarded by any organization or association. Certification, legally understood, is the "formal assertion in writing of some fact" (Black 1990:227). In contrast, licensing is the regulation of a profession by a government. Seen from the legal perspective, professional licensing gives "permission to do what is otherwise restricted, prohibited or illegal" (Walker 1980:769). Licensing is the government exercise of its police power, which is the constitutional law concept that empowers the government to restrict an individual's freedom to protect "public safety, health, and welfare."

The relevant difference between certification and licensing is governmental regulation and restriction of activities. Based on the legal distinction, any organization can certify people under its own authority, whereas licensing is established only through governmental legislation. Unfortunately, the terminological distinction is thoroughly muddled in practice. Certificates of licensing are awarded. The term "certified" is often mistakenly used to designate licensed persons. For example, Texas State law provides for both certified and licensed real estate appraisers. From the legal point of view, because this certification is state-controlled and legally required, a state-certified real estate appraiser actually has a form of license (Texas Appraiser Licensing and Certification Board 2001). This terminological imprecision also masks the common practices through which professional associations provide documents and criteria that legislative acts implement as licensing law and requirements. In this way, certification criteria developed by a professional group can evolve and in effect become a protectionist means to control entry to a professional field (Wilson 2001).

For this article, these distinctions are highly important. Whereas public safety concerns are always the fundamental issue in licensing, the same concerns can become highly relevant to, although not a legal foundation for, certification. Related to this, the question arises whether certification raises liability issues and implicit legal responsibilities.

Two Case Studies

Two recent controversial issues provide case studies to illustrate the thesis of this article. In the first case study, I set the stage for considering the roles of scientific, political, and philosophical issues involved in licensing and certification. This case study draws on a recent debate among members of the Association of Computing Machinery (ACM) regarding the licensing of software engineers. The second case study frames these issues in the GIS context. It provides an overview of recent activities by the National Council of Examiners for Engineering and Surveying (NCEES) to establish a new model law for the licensure of engineers and land surveyors.

The ACM Software Engineer Licensing Debate

The ACM was founded in 1947 and currently has 80,000 members. Although much larger than any GIScience or geography association, the ACM is comparably diverse with approximately 38 specialty groups; there are more than 50 specialty groups in the Association of American Geographers. Considering this breadth, the underlying scientific, political, and philosophical issues identified by the ACM hold lessons for current discussions about GIS professional certification and licensing issues for the GIScience community at large.

In May 1999, following the report of a specially commissioned panel and committee deliberations, the ACM Council concluded that "…there is no form of licensing that can be instituted today assuring the public safety" (Allen et al. 2000). As the panel stated, "the primary arguments for licensing are that it will happen with or without the involvement of the ACM and that the development of license standards will, at a minimum, strengthen software development knowledge and practice" (ACM Panel on Professional Licensing in Software Engineering 1999). Wary of implying an endorsement of existing licensing schemes, the Council decided that the ACM would withdraw from any activity that gave the appearance of condoning the licensing of software engineers. Specifically, the ACM Council adopted the panel on professional licensing in software engineering majority's recommendation that licensing "does not address the software quality problem and is premature."

The ACM Council decision to oppose software engineer licensing was based on consideration of three critical issues for GIS public safety concerns: scientific merit, political issues, and philosophical concerns. The scientific merit issue that the ACM considered revolves around this question: "Is there a test [licensing exam] that will assure the person who passes the test will be qualified to write programs that would never endanger the public? Will that person be qualified to sign off on program designs to assure they are sound, just as building designs are signed by structural architects to assure the building is sound?" (Allen et al. 2000:29). The Council and committees looking into this issue found no test to assure a software program design that would assure public safety. Further, they found that no one knows how to prepare such a test. Without building codes for programs and a vocabulary rich enough to discuss their structural integrity, the Council called for more research upon which such a test can be derived.

Political issues often remain in the background of certification and licensing discussions, masked by ostensible concerns with public safety, health, and welfare, but many times may be the underlying motivations for professional groups seeking to control a profession. The political rationale for licensing and certification is directly connected to the size and influence of disciplinary associations. For the ACM, the political issue is inseparable from economic concerns: "As traditional engineering disciplines attract fewer people than the software construction/programming disciplines attract, those groups who make their money from fees derived from licensing and accrediting engineers will look upon software engineers as a good growth area and attempt to assert their control" (Allen et al. 2000:29).

The ACM Council also discussed two philosophical concerns. The first was whether to participate in licensing activities even though the Council did not approve of licensing. Going with the majority of the panel, the Council decided that participation would be perceived as an endorsement and would "lull people into thinking we do know how to assure public safety when we don't" (Allen et al. 2000:30). The second philosophical point is the question of when to begin licensing. Some panelists hoped that beginning the licensing process would help mature the field. The Council determined that the possible harm of licensing—the consequences of using incomplete and insufficient licensing requirements—outweighs any possible good.

Although the ACM withdrew from active participation in the development of a licensing examination, it continues to work with the Institute of Electrical and Electronics Engineers (IEEE) Computer Society on definitions of an appropriate corpus of knowledge and standards for software engineering. Two task forces were formed to assess these issues and evaluate all options for ensuring public safety. Although the ACM currently opposes licensing of software engineers since no form of licensing ensures public safety, these task forces will focus on solving the software quality problem.

The scientific, political, and philosophical issues the ACM addressed are directly relevant for GIS certification and licensing discussions. The same questions that the ACM raised can be asked of GIS certification and licensing:

- Is there a test [licensing exam] that will assure the person who passes the test will be qualified to conduct GIS projects that would never endanger public safety?
- Are groups attempting to use licensing/certification as a means to generate income for their professional organizations and assert control over a burgeoning field?
- Does the participation in licensing and certification proposals indicate tacit approval of incomplete and insufficient criteria?

These questions should be discussed publicly through an open and frank discussion by the numerous groups involved in activities that GIS licensing or certification would encompass. This joint discussion may take some time. In the meantime, the public safety concerns of GIS remain. Some groups have taken on these issues directly (NCEES, see below), while others include them implicitly in their activities (American Society for Photogrammetry and Remote Sensing (ASPRS), the Urban and Regional Information Systems Association (URISA), and the University Consortium for Geographic Information Science (UCGIS)).

The NCEES Model Law

The NCEES Model Law for the Licensure of Engineers and Land Surveyors is intended to be used as "a reference work in the preparation of amendments to existing legislation or in the preparation of new proposed laws" (NCEES 2001:5). Building such a model law is tricky business. While surveyors are concerned that the wording of the model law may prohibit "them from doing the work they have historically been conducting" (Joffe 2001:35), other professionals feel threatened by the appearance of a broadening of the duties covered under legal licensure. The Model Law is important for all GIScience practitioners concerned with public safety issues.

The NCEES Model Law offers a thought-provoking example of how one professional group (surveyors) addresses public safety concerns. While much of the Model Law focuses on the constitution and maintenance of a board to organize the licensing process, it offers ample insights into the legal issues surrounding licensing and the protection of public safety. For this section, I am citing and drawing on the Model Law published in August 2001 (NCEES 2001). Discussion and working papers available at the NCEES (www.ncees.org) and the American Congress on Surveying and Mapping (ACSM) (http://www.acsm.net/nceegislis.html) provide additional insights. To improve comparability, the scientific, political, and philosophical issues framework described by the ACM Council is used here to organize an analysis of the Model Law and background documents.

Scientific Issues. The Model Law allows graduate surveyors with 4 years of combined office and field experience to be admitted to an 8-hour written examination on the principles and practice of surveying or land surveying whose contents are determined by the board. The lack of specifics for the test in terms of public safety issues is somewhat compensated by the definition section of the Model Law. The activities identified in a non-exclusive list include the measurement of lines and angles to position fixed objects, property line and boundary work, land subdivision, locating and setting of survey monuments and reference points, and the use of GIS to perform these activities. These exemplar activities undergird some of most common surveying activities.

However, in the Model Law, the practice of surveying is not limited to the list of activities:

> The term "Practice of Surveying or Land Surveying," within the intent of this Act shall mean providing professional services such as consultation, investigation, testimony evaluation, expert technical testimony, planning, mapping, assembling, and interpreting reliable scientific measurements and information relative to the location, size, shape, or physical features of the earth, improvements on the earth, the space above the earth, or any part of the earth, and utilization and development of these facts and interpretation into an orderly survey map, plan, report, description, or project. (NCEES 2001)

Considerable concern has been raised in the GIS community at large regarding the inclusive nature of the definition that seems to include any scientifically measured representation of the earth's surface. The GIS/LIS report from October 2000 addressed this issue (GIS/LIS 2000) noting that the definition should exclude activities with low regulatory interest and activities not part of the "Practice of Surveying or Land Surveying" affecting "the health, safety or welfare of the public" (GIS/LIS 2000:3). Joffe (2001: 36) suggested that a critical distinction can be made between GIS products "intended to be used as the authoritative document for the location of parcels, fixed works, survey monuments, elevation measurements, etc." and those used for other purposes.

Recently, NCEES and the surveying community have moved toward a less inclusive definition. Suggested changes outlined in the Draft Preliminary Report of a task force of representatives from several of the professional organizations representing GIS professionals stipulate that professional surveying only include "Geographic Information System-based parcel or cadastral mapping used for authoritative boundary definition purposes wherein land title or development rights for individual parcels are, or may be, affected" (ASPRS 2002:12). Nevertheless, this controversy leaves open the debate regarding the definition of the field and thus the question of what should be tested to assure competence of licensed surveyors across the domain that they are expected to serve.

Political Issues. As it stands, the broad definition of the "Practice of Surveying or Land Surveying" suggests a political intent. By making the definition so inclusive of professional services including planning, mapping, etc., practitioners wishing to continue data collection and mapping in jurisdictions that have implemented the Model Law in this form would be required to become licensed surveyors. Analogous to attempts of related fields to colonize areas of software engineering reported by the ACM Council, this appears to be an attempt to put into place a licensing requirement that would place control of all professional GIS activities in the hands of licensed surveyors. In one of the activities listed, "planning," the U.S. planning field already has its own certification program. Generally, two reasons go against this kind of all-encompassing definition of surveying. On the one hand, this definition fails to include all related activities that affect public safety (e.g., GPS car navigation). On the other hand, the definition becomes so inclusive that the precise demarcation of surveying practice would require litigation. As it appears the suggested changes will be included in a revision of the Model Law due out in the summer of 2003 (Joffe 2002), these political issues seem to have been partially resolved.

Philosophical Issues. Since the NCEES has already promoted the Model Law and it has become the basis for the licensing of surveyors in South Carolina and other states, the philosophical issues regarding whether and when to undertake licensing in these GIS-related fields that the ACM Council identified are indeed moot.

Public Safety In GIS Certification and Licensing

Having examined some of the current discussions related to public safety and licensing in other fields, we can now turn to a consideration of how public safety issues are accounted for in current GIS certification and licensing activities. Again, it is worthwhile to consider the scientific, political, and philosophical issues. As might be expected, published documents on GIS certification contain little reference to public safety. The University Consortium for Geographic Information Science white paper titled Educational Policy and GIS: Accreditation and Certification (Obermeyer and Onsrud 1997) does not mention public safety, assuming that certificates only show a level of education or training. It even argues that UCGIS members should have little interest in certification since it would dilute the meaning of the academic degrees they award. In a later article, Obermeyer (2000) articulates the political and philosophical rationale for involving UCGIS in the certification discussion but states nothing about public safety. On the other hand, Huxold (2000) points implicitly to the importance of public safety. Taking up earlier work on certification, one of Huxold's three benefits of GIS certification is "Public benefit by the encouragement of higher levels of competency among practitioners." While public benefit is not necessarily synonymous with public safety, it does promote awareness of issues that overlap.

In discussions among surveyors, the GIS and public safety issue is foremost. Surveyors are very aware of the related scientific, political, and philosophical issues (Joffe 2001). For example, articles on certification and licensing in the Professional Surveyor deal with the control of GIS, the relationship of GIS to surveying and geomatics, and the cost of inaccurate data bases (Henstridge 1999, Schmidt 1999). In literature discussing GIS certification and licensing, the clearest articulation of the role of public safety comes from Jim Plasker, executive director of the American Society for

Photogrammetry and Remote Sensing, in a GeoSpatial Solutions article organized and edited by Rebecca Somers (2000). Discussing the NCEES contributions to revisions of the Model Law, Plasker makes clear that the reason for licensed surveyors' attention to certification and licensing is protection of the public: "Recent developments in GIS and related data acquisition technologies now make it possible for unregulated practitioners to accomplish certain surveying activities that, if not completed properly, would be detrimental to public safety or individuals' property rights" (Somers 2000:28). Corresponding to the ACM's political category, Plasker makes it clear that the surveyor's concern for public safety goes hand-in-hand with the concern that high accuracy measurements made by GIS users "will inadvertently encroach on the regulated practice of surveying" (Somers 2000:28).

All of these arguments demonstrate that it is important for GIS professionals to consider the science, politics, and philosophy of GIS certification and licensing in relationship to public safety. Without tests or standards that assure public safety, the current GIS certification and licensing discussion may be seen to be little more than an attempt to stake out professional turf. As the examples above demonstrate, licensing and certification proponents' calls for certification may reflect strong political motivations—the control of a field through certification or legislation can serve to protect the economic interests of people who define and maintain the instruments of licensing and certification.

However, a more fundamental question remains: Do certificates matter? Most people advocating certification refer to its usefulness in evaluating job candidates, in helping professionals design their own professional development activities, and in the establishment of mechanisms to assure continuing education such as those provided for their certified professionals by the American Institute of Certified Planners' or the American Institute of Architects' Continuing Education System. Depending on whether you are an employer or looking for employment, your perspectives will vary. While certificates such as the Microsoft Certified Systems Engineer certification are vendor issued and indicate the tested achievement of a skill level, point-based certification approaches such as that being promoted by URISA, which account for a lifetime of education and experience, can become so nonspecific as to be meaningless for employers looking for concrete measures of job candidates' skills and abilities. If GIS certification can be acquired through an infinite number of paths, how will it become useful for job seekers looking to distinguish their abilities? In this author's opinion, the vagueness of the current URISA certification proposal lacks specific indicators to make GIS certificates alone meaningful. [Editor's note: See the report in this issue by Huxhold and Craig for a very different perspective on the role of GIS professional certification.]

Important Questions For Education

The ACM Council's deliberations and decision should serve as a touchstone for our critical examination of what certification should accomplish in GIS. Is there a role for the consideration of public safety in the GIS certification initiatives? If so, what are the scientific, political and philosophical implications? From the philosophical perspective that the ACM raises, educators will need to ask whether GIScience is ready for certification—do we have guidelines, practices, and criteria to teach, and tests to administer that can assure public safety? If public safety is a key reason for undertaking certification of GIS professionals, it would be disingenuous to assert that it is called for when there are no grounds to assess how certification or licensing would assure public safety.

Whether or not public safety issues drive GIS certification, there is some value in GIS educators and researchers beginning to ask how they can help to develop GIS practices, tests, and criteria that assure public safety. The ACM pointed to quality as a key dimension of software engineering, and that may be an equally suitable starting point for GIS. Geographic information science can contribute to the development of quality and practice criteria to inform discussions about public safety concerns. It is important to recall that the first papers on data quality dealt with the use of GIS in public offices charged with assuring equitable policy and maintaining public safety (Chrisman 1984). Recent work on data quality presents measures of quality and means of making quality information more accessible for public decision-making (Morrison 1995, Egenhofer 1997, Widmer 1997, Goodchild 1998, Harvey 1998, Chrisman 1999;). Likewise, the division between authoritative and location-referencing GIS activities now being proposed in the NCEES Model Law revisions begins to distinguish GIS products and activities according to their importance to public safety.

Despite the difficulty of establishing certification criteria that ensure public safety, discussions surrounding certification will help to articulate a core body of knowledge in GIS and GIScience, identify standards of practice, and promote research in this area. In terms of education, consideration of public safety issues should become part of curricula preparing individuals for future careers. While we should be wary of locking in standards that may become outdated quickly, a fundamental awareness of public safety issues can and should be appropriately anchored in GIScience education.

Conclusion

The question whether GIS certification can and should, in the broadest sense, satisfy public safety concerns has yet to be directly addressed by the GIS community. Taking into account the diversity of the GIScience field, our professional activities, and social commitments, the time is simply too early for meaningful GIS licensing that assures public safety. Considering the breadth of GIS, we are not yet ready to answer the question: "What qualifications must a person possess to assure their work with GIS will never endanger the public?" Although public safety concerns currently play a less significant role in certification than in licensing, they are still crucial for assuring the quality of GIS work and understanding the consequences of inappropriate practice. Public safety is a key issue for GIS licensing and certification and should form an important foundation in GIS education. Without appropriate consideration of public safety, we run the risk, like any profession, of damaging the public reputation of GIS.

About the Author

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Building the Geospatial Workforce

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Abstract: *In response to an increase in the number of skilled workers needed to sustain the geospatial workplace, the Geospatial Workforce Development Center developed the Geospatial Technology Competency Model that identifies the roles, competencies, and outputs for the geospatial technology industry. A rigorous research methodology was utilized to develop a competency model that integrates the technical, business, analytical, and interpersonal skills required for the geospatial marketplace. Organizations can use the Geospatial Technology Competency Model to describe the kinds of workers needed in the geospatial information technology industry, improve employee recruitment and selection, manage the performance of existing employees, and design geospatial information technology training and education programs.*

Introduction

The worldwide market for geospatial technologies has enormous market potential. Currently estimated at $5 billion, the market is projected to have annual revenues of $30 billion by 2005 (remote sensing market: $20 billion; geographic information services market: $10 billion). In the mapping market alone, worldwide annual revenues for satellite and aerial data products are estimated to increase from $2.2 to $4.2 billion over the next 5 years. High-resolution satellite imagery product revenues are estimated to increase from $1.4 to $3.8 billion in the same period. In the United States, remote sensing industry annual revenues are projected to increase steadily from the 1992 benchmark of $0.75 billion to $4 billion by 2005 (National Aeronautics and Space Administration (NASA) 2001).

As an emerging growth industry, there is a serious shortfall of professionals and trained specialists who can utilize geospatial technologies in their jobs. The growth of this market demands support of the education, training, and development of geospatial professionals and specialists. A strategy is required to meet the challenge of providing a well-trained workforce while at the same time perpetuating an expanding market of persons trained, familiar, and ready to apply geospatial technologies when solving workplace and societal challenges.

The Office of Education and the Earth Science Applications Directorate (formerly the Commercial Remote Sensing Program) at the NASA John C. Stennis Space Center implemented the National Workforce Development Education and Training Initiative (NWDETI) in an effort to develop a well-trained geospatial workforce. The Geospatial Workforce Development Center (GeoWDC) at The University of Southern Mississippi is part of this initiative. NWDETI is a customer-focused effort to meet workforce demands for the emerging multi-billion dollar geospatial industry and to help the U.S. maintain its global leadership in geospatial technologies.

The Geospatial Workforce

With increased market potential comes an increased need for a systematic approach to developing a workforce to support industry growth. The workforce planning process must be a customer-driven process that determines workforce needs and provides the foundation for appropriate training and education opportunities.

Concurrent with the growth and development of the geospatial industry is an increased research interest in geospatial workforce training and development. For example, the Urban and Regional Information Systems Association (URISA) has led an effort to create and implement geographic information system (GIS) certification with the goal of establishing workplace standards for the GIS industry (http://www.urisa.org). Other organizations such as the Association for Geographic Information (http://www.agi.org) have been actively involved in conducting job and task analyses to create a set of skill profiles for GIS positions in the U.S. and the United Kingdom. The University Consortium of Geographic Information Science (http://www.ucgis.org) has focused efforts on the academic preparation of GIS professionals by developing a model curriculum. Current activities related to professional certification in GIS are documented and available at http://institute.redlands.edu/users/kemp/certification/. The American Society for Photogrammetry and Remote Sensing (http://www.asprs.org) has also been involved with developing a remote sensing core curriculum.

Efforts to understand the geospatial industry needs and academic preparation requirements have not gone without some debate. Certification, accreditation, and licensure – each with a different purpose and focus – have struggled for definition within the geospatial profession (Huxhold 1991, Goodchild and Kemp 1992, Obermeyer 1993). In fact, the categorization of GIS as a profession with standards is part of the debate. Academic programs supporting GIS education, according to Wikle (1999), vary in the structure, duration, sponsorship, and intended student population.

Given the lack of agreement on GIS as a profession, the most appropriate academic program to prepare those who would work in this "profession," and the absence of recognized standards or industry certification, it is no surprise that organizations equipped with increased geospatial technology capabilities for decision support are questioning the kind of people to hire. The scope of this study is to better understand the work being done by geospatial technology professionals and the work roles they perform in their organizations.

While the authors acknowledge and understand the continuing challenges related to the development of educational responses to these issues of debate, the purpose of this research is to focus on the work needs as they exist in the geospatial industry and how a market-driven approach can better assist in the workforce planning process. One such process is the use of a competency model because it provides a more comprehensive and flexible approach to identify those workforce competencies required by the geospatial profession.

Competency Models

The roots of competency models date back more than 20 years, and represent a process that was popularized by the late psychologist, David McClelland. According to Briscoe and Hall (1999), the major approaches to developing a competency framework are accomplished using a research-based, strategy-based, or a values-based approach. The recent resurgence in applying competency models helps organizations and whole industries focus on what is needed to succeed in today's workplace.

Perhaps part of the renewed interest in competency models is the shift in workforce development from a focus on workplace activity to workplace results. Organizations need a framework for workforce development to help them achieve the results needed for success. Creating a workforce development plan requires an analysis of the work that is required. With the changing nature of jobs and work, the concept of a "job" is becoming obsolete. In many high-technology industries, cross-functional project teams are common and employees shift from project to project throughout the year. Even the job of managers changes in such situations, for they must serve their project teams as facilitators, gatherers of resources, and removers of roadblocks (Mathis and Jackson 2000). What has become apparent, given the cross-functional nature of work and the speed with which technology changes work tasks and responsibilities, is a more flexible technique for approaching workforce development. Traditional job and task analyses are not flexible and often become obsolete by the time they are complete.

Today's fast-changing workplace requires that the basis for recruiting, selecting, and compensating individuals is their competence and skills, rather than a job title. The best approach to develop a workforce is to focus less on specific tasks and duties and more on identifying work-related competencies. Competencies can be described as "behaviors that distinguish effective performers from ineffective ones" (Dalton 1997:48), can include motives, beliefs, and values (Mirabile 1997), and are generally representative of the tasks and activities used to accomplish a specific job (McLagan 1996). Groups of competencies typically include knowledge, skills, abilities, or characteristics associated with high performance on the job. Knowledge is the understanding needed for a particular subject or process, while the skills would include both the technical and nontechnical requirements to accomplish a task. Abilities are those appropriate on-the-job behaviors needed to bring both knowledge and skills to bear (LeBleu and Sobkowiak 1995).

When competencies are identified, they should be organized and presented in a meaningful way for use by employees, hiring organizations, and curricula developers. The resulting framework of competencies is a competency model. The term "competency model" refers to the knowledge, skills, and abilities identified for successful performance for a particular organization or industry. Pat McLagan defines competency model as "a decision tool that describes the key capabilities for performing a specific job (1980: 23)."

A competency model is a set of success factors, often called competencies, that include the key behaviors required for excellent performance in a particular role. Excellent performers on-the-job demonstrate these behaviors much more consistently than average or poor performers. These characteristics include key behaviors that drive excellent performance. These characteristics are generally presented with a definition and key behavioral indicators. (Sanchez 2000:510)

"The construction of a competency model calls for the correct identification of the critical competencies required for effective performance (Ingalls 1979:32)." In order to achieve "correct identification," the designer of the model must conduct extensive research into the company or industry concerned with workforce development. Role experts—individuals who function in specific areas of expertise in their job—must be interviewed. A common mistake during the design process is that management, without input from role experts—makes decisions about the skills necessary to perform a certain job. "Building a so-called competency model based solely on the beliefs and opinions of a group of people, albeit powerful people, makes it a useless exercise (Dalton 1997:48)." The "useless exercise" yields an "ideal"—and often impractical—model rather than a model displaying the expected outcomes. Role experts provide input so that the expected model lends itself to flexibility. The model looks to the future rather than just the present, and the model is not specific to the job. Because of the focus on competencies instead of job titles or job descriptions, the model can grow and develop with the changing needs of the organization or industry.

Competency Model Benefits

Competency modeling is an attempt to describe work and jobs in a broader, more comprehensive way (Zemke and Zemke 2000). Competency-based performance models yield a common language across positions within an industry. It is the best approach when creating a performance management system, and it enables workforce development professionals to identify core capabilities required of any employee in any position across an entire organization or industry (Gilley and Maycunich 2000). Robinson and Robinson (1996) encourage the use of a performance model when describing "should" performance for a specific position or job cluster.

In addition to performance management benefits, results from competency models can be easily translated into training curricula. While training programs based on work-oriented task analysis can become dated as work undergoes dynamic change, training programs based on competency assessment are more flexible and perhaps have more durability (Bohlander et al. 2001).

The Geospatial Technology Competency Model (GTCM) developed at The University of Southern Mississippi most importantly provides a way to articulate the kinds of workers needed in the industry. The GTCM provides a research-based set of competencies for hiring organizations to use to improve employee recruitment and selection and to create competency-based performance management systems to help professionally develop existing employees in the industry. Finally, the GTCM offers a research framework for training providers and academic institutions to use for creating the most effective and efficient training and education opportunities.

Research Methodology

The methodology for the study was conducted in several major research phases designed to systematically analyze and validate geospatial technology workforce requirements.

Phase One

The first phase was to review current literature and identify existing skills and standards for related roles, competencies, and outputs for the geospatial industry. This phase is consistent with Lucia and Lepsinger (1999), wherein researchers seek to build on and validate existing competencies. Additionally, this phase sought to identify existing geospatial stakeholder organizations in order to create a task force of geospatial technology experts. Through an iterative process, this task force provided input and feedback for a preliminary list of geospatial competencies derived from an extensive literature review.

Phase Two

Subsequent to the creation of a preliminary list of competencies, the second phase of the research methodology was initiated, consistent with McLagan and Suhadolnik (1989) methodology to involve industry stakeholders. For Phase Two, individuals were identified to participate in focus group sessions designed to bring together active participants in the geospatial industry from public and private organizations both large and small, trade and professional associations, and educational institutions. Collectively, focus group participants represented more than two hundred years of geospatial technology expertise and experience brought to the table for each focus group session. These diverse stakeholders were charged with defining and reaching consensus for a baseline definition of the geospatial industry and determining present and future workforce needs for the industry. In addition, focus group participants were asked to identify geospatial work roles and to review international geospatial workforce standards. For a detailed listing of all focus group participants, see the Workforce Development Models for Geospatial Technology report, accessible on the GeoWDC Web site http://www.geowdc.usm.edu.

Phase Three

A first draft of the GTCM was the result of the third phase of the research methodology. For this phase, focus group participants who are considered industry stakeholders utilized a group decision support system made available by the NASA John C. Stennis Space Center. The focus group activities centered on (a) validating the roles and role definitions created in the second phase, (b) identifying the products and services provided by geospatial technology professionals and the quality requirements associated with each, (c) identifying ethical challenges and future forces for the geospatial technology workforce, and (d) defining the required workplace competencies for each work role.

In order for the GTCM to have meaning and relevance for those who will ultimately use the model, industry stakeholders were involved from the beginning to help guide competency model development. The early participation gave members of the geospatial community the opportunity to review the scope of the study, revise role definitions and outputs, and revise preliminary competency menus. This effort helped structure activities for focus group participants who were considered industry stakeholders. Representatives from the following organizations participated in focus group sessions for this study:

- American Society for Photogrammetry and Remote Sensing
- Environmental Protection Agency
- Environmental Systems Research Institute
- Federal Emergency and Management Agency
- Geospatial Information Technologies Association
- Global Initiatives, Inc.
- Louisiana Department of Environmental Quality
- Mississippi State University
- National State Geographic Information Council
- Pennsylvania Department of Military and Veterans Affairs
- Spatial Technologies Industry Association
- University Consortium for Geographic Information Science
- Urban and Regional Information Systems Association
- U.S. Department of Interior, United States Geological Survey (USGS), Earth Resources Observation Systems (EROS) Data Center
- U.S. Department of Labor
- U.S. Naval Oceanographic Office

Focus group data were analyzed and interpreted, resulting in the preliminary draft of the competency model. Additionally, Phase Three provided a quantified matrix of the work roles, role definitions, outputs for each role, quality requirements for each output, ethical challenges for each role, and future forces for the geospatial industry.

Phase Four

Using the matrix developed above, Phase Four research activities included the development of survey questionnaires for each role and validation of the preliminary competency model by exemplars or top performers for each role. According to McLagan (1997), the use of role experts is a generally accepted way to have job experts pool their experience and expertise to define work and competencies. Phase Four allowed role experts the opportunity to validate the geospatial roles, competencies, outputs, and quality requirements defined by industry stakeholders in previous focus group sessions.

Since the deliverables (outputs) for each role are unique, separate questionnaires were required for each of the 12 geospatial technology work roles. Face-to-face interviews were conducted with role experts, or exemplars, currently working in the geospatial industry. Employees from more than 28 companies in 15 major cities across the U.S. participated as role experts. Of the 119 role experts interviewed, 67 (56%) were from the private sector and 46 (39%) represented public organizations. In addition, the researchers sought to balance Fortune 500 with small business organizations, and to include role experts working with a variety of end-user applications.

It should be noted that the research methodology did not use a random sample of geospatial technology professionals. Instead, competency modeling methodology requires a purposeful sample of qualified respondents who meet exemplar criteria. Furthermore, to ensure the integrity of the role expert data collection process, face-to-face questionnaire administration was used instead of traditional survey data collection techniques (i.e., mail, online, or phone interviews).

When presented with the preliminary list of competencies, 119 role experts in Phase Four were asked to identify the level of importance and the level of expertise for each competency required in their work role. The following scale was used to rank the importance of competencies:

0 – insignificant
1 – minimal importance
2 – moderate importance
3 – somewhat important
4 – very important
5 – critical

In addition, role experts were presented with checklists to validate the outputs and quality requirements that best demonstrate excellent performance for the role in which they had been identified as an exemplar. McLagan and Suhadolnik (1989) criteria were used to interpret the data for the final competency model. Data analysis required that at least 75% of the role experts for an individual role agree that the quality requirements were appropriate for a specific output. Data collected from these face-to-face role expert interviews were tabulated and analyzed using SPSS to create the final model.

Results

Industry Definition

A definition was written by industry stakeholders early in the process to ensure participants answered questions from the same industry perspective. Research participants included those whose primary expertise and experience was remote sensing, as well as those with primary expertise and experience in GIS. Initial focus group discussions focused on the differences between remote sensing and GIS workforce requirements. However, during focus group session activities, participants recognized and determined that the workforce requirements were not remote sensing- or GIS-specific, but rather represented a broader industry domain they labeled geospatial technology.

Consensus was reached among focus group participants for the following industry definition:

> Geospatial technology is an information technology field of practice that acquires, manages, interprets, integrates, displays, analyzes, or otherwise uses data focusing on the geographic, temporal, and spatial context. It also includes development and life-cycle management of information technology tools to support the above.

Geospatial Roles and Role Definitions

The heart and soul of the Geospatial Technology Competency Model are the roles, competencies, and outputs for geospatial work. "Competency" is defined as the knowledge, skills, and abilities an individual needs to do their job; "role" is not a job description, rather it is a grouping of competencies targeted to meet specific expectations of a job or function. An "output" is a product or service that an employee or group of employees delivers to customers, clients, colleagues, or coworkers.

As shown below in Table 1, 12 distinct work roles were identified by focus groups for the geospatial technology industry.

Outputs (Deliverables) and Quality Requirements

In addition to the 12 geospatial technology roles defined by focus group members, 138 key products or services (outputs) were identified that are a result of performing the day-to-day activities in a particular role. Also generated was a list of quality requirements necessary to produce an excellent product or service. In other words, how will one recognize that a deliverable (output) is excellent? Role experts validated outputs and quality requirements during face-to-face interviews.

An example of an output identified in the role of "Data Acquisition" is metadata. The quality requirements for metadata identified by focus groups and validated by role experts are that metadata: ensures correct attribution, is created in a format that is compliant with company/customer policy, is comprehensive, is accurate, is in a correct/consistent format, and is compliant with

TABLE 1 Geospatial Technology Role Definitions	
Applications Development	Identify and develop tools and instruments to satisfy customer needs
Data Acquisition	Collect geospatial and related data
Coordination	Interorganizational facilitation and communication
Data Analysis and Interpretation	Process data and extract information to create products, drive conclusions, and inform decision-making reports
Data Management	Catalog, archive, retrieve, and distribute geospatial data
Management	Efficiently and effectively apply the company's mission using financial, technical, and intellectual skills and resources to optimize the end products
Marketing	Identify customer requirements and needs, and effectively communicate those needs and requirements to the organization, as well as promote geospatial solutions
Project Management	Effectively oversee activity requirements to produce the desired outcomes on time and within budget
Systems Analysis	Assess requirements for system capacities including inputs, outputs, processes, timing, and performance, as well as recommend necessary additions or adaptations
Systems Management	Integrate resources and develop additional resources to support spatial and temporal user requirements
Training	Analyze, design, and develop instructional and non-instructional interventions to provide transfer of knowledge and evaluation for performance improvement
Visualization	Render data and information into visual geospatial representations

standards. For a listing of all outputs and quality requirements by role, see the Role Profiles section of the Workforce Development Models for Geospatial Technology accessible on the GeoWDC Web site http://www.geowdc.usm.edu.

Competencies

Data analysis and interpretation yielded 39 geospatial technology competencies as depicted in Table 2 below. These competencies are the key areas of knowledge and skill that enable individuals to perform geospatial technology work or to produce the outputs or key deliverables for their jobs.

For a competency to be defined as important for a specific role, a mean rating of at least 3.5 on the importance scale or a 4.0 mean rating by at least 50% of the role experts responding for a single role was required. When interpreting responses from all role experts combined, 15 competencies yielded a mean rating of at least 3.5 on the importance scale. These 15 core competencies determined to be critical for the overall geospatial technology industry are shown in Table 3 in bold print.

Geospatial technology competencies were organized into four categories: technical, business, analytical, and interpersonal (Table 3). For geospatial technology professionals to be successful in today's marketplace, it is critical to understand that the knowledge, skills, and abilities required for their jobs include a blend of technical, business, analytical, and interpersonal competencies. Not surprisingly, geospatial technology professionals do not operate in a technical vacuum. They are required to demonstrate competencies in all four categories depending upon the roles they occupy. This blend of technical and non-technical workforce requirements is not unique to this industry, but this blend is too often overlooked during the workforce planning process.

The final table shown (Table 4) is the Geospatial Technology Competency Model that identifies competencies in four categories required for the 12 geospatial technology roles. This matrix is a big picture view of the knowledge, skills, and abilities needed in the geospatial marketplace. For a breakdown of the competencies by role, including the level of expertise required for each competency by role, visit the profiles section of the previously cited report accessible at http://www.geowdc.usm.edu.

Conclusion

This article describes the methodologically rigorous approach used to develop the Geospatial Technology Competency Model. The Competency Model approach provided the best framework for defining the workforce requirements for the geospatial marketplace. However, no study is without limitations. First, the authors recognize that industries are not static, and this is particularly true

TABLE 2 GEOSPATIAL TECHNOLOGY COMPETENCY DEFINITIONS
Ability to Assess Relationships Among Geospatial Technologies – examining the effects of geospatial technologies on parts of an organization, as well as the effects on the organization's interactions with customers, suppliers, distributors, and workers
Ability to See the "Big Picture" – identifying trends and patterns that are outside a normal paradigm of the organization sources
Business Understanding – demonstrating awareness of the inner workings of business functions and how business decisions affect financial or non-financial work results
Buy-in/Advocacy – building ownership or support for change among affected individuals, groups, and other stakeholders
Cartography – organizing and communicating geographically related information in either graphic or digital form
Change Management – helping people adapt to the changes brought on by new technologies and helping them to see the value and benefits of new technologies
Coaching – helping individuals recognize and understand personal needs, values, problems, alternatives, and goals
Communication – applying effective verbal, nonverbal, and written communication methods to achieve desired results
Computer Programming Skills – being able to understand and use a set vocabulary and grammatical rules for instructing a computer to perform a specific task; knowledge of high-level languages; ability to create or revise a program
Conflict Management – helping people work together to resolve disputes through constructive processes and techniques
Cost Benefit Analysis/Return on Investment (ROI) – understanding the relative costs of each geospatial technology, or combination of geospatial technologies and assuring that the organization is receiving a good value for the dollars spent on these technologies
Creative Thinking – recognizing, exploring, and using a broad range of ideas and practices; thinking logically and creatively without undue influence from personal biases
Environmental Applications – applying GIS technologies for environmental assessment or management purposes
Ethics Modeling – modeling exemplary ethical behavior and understanding the implications of this responsibility.
Feedback Skills – communicating information, opinions, observations, and conclusions so that they are understood and can be acted upon
Geology Applications – applying GIS technologies for geological purposes
Geospatial Data Processing Tools – knowing and being able to apply the skills needed to operate currently used geospatial data processing tools
GIS Theory and Applications – understanding the theory behind GIS and being able to identify and implement modern day applications for it
Group Process Understanding – understanding how groups function; influencing people so that group, work, and individual needs are addressed
Industry Understanding – demonstrating awareness of the vision, strategy, goals, and culture of the geospatial technology industry

Table 2 continued

Knowledge Management – the efforts to systematically find, organize, and make available a company's intellectual capital and to foster a culture of continuous learning and knowledge sharing so that organizational activities build on existing knowledge
Leadership Skills – influencing process of leaders and followers to achieve organizational objectives through change
Legal Understanding – ability to understand legal issues affecting the application of geospatial information technology
Model Building Skills – conceptualizing and developing theoretical and practical frameworks that describe complex ideas in understandable, usable ways
Organization Understanding – seeing organizations as dynamic, political, economic, and social systems that have multiple goals; using this larger perspective as a framework for understanding and influencing events and change that can impact implementation and support of geospatial technologies
Performance Analysis and Evaluation – the process of comparing actual and ideal performance in order to identify performance gaps or opportunities
Photogrammetry – recording, measuring, and plotting electromagnetic radiation data from aerial photographs and remote sensing systems against land features identified in ground control surveys, generally in order to produce planimetric, topographic, and contour maps
Problem-Solving Skills – the ability to consider alternative courses of action and select and implement appropriate solutions
Questioning – gathering information from stimulating insight in individuals and groups through use of interview, questionnaires, and other probing methods
Relationship Building Skills – establishing relationships and networks across a broad range of people and groups
Remote Sensing Theory and Applications – understanding the underlying theories related to acquiring an object without contacting it physically such as aerial photography, radar, and satellite imaging
Research Skill – selecting, developing, and using methodologies such as statistical and data collection techniques for formal inquiry
Self-Knowledge / Self-Management – knowing one's personal values, needs, interests, style, and competencies and being able to manage their effects on others
Spatial Information Processing – the process of modeling, examining, and interpreting model results necessary for evaluating suitability and capability, for estimating and predicting, and for interpreting and understanding
Systems Thinking – identifying inputs, throughputs, and outputs of a subsystem, system, or suprasystem and apply that information to improve the application of geospatial technologies; realizing the implications of geospatial technology or many parts of an organization, process, or individual; taking steps to address the impact of applying these technologies
Technical Writing – the ability to "translate" technical information to nonspecialists
Technological Literacy – understanding and appropriately applying existing, new, or emerging technologies
Topology – understanding how map features represented by points, lines, and areas are related, with specific emphasis on the issues of connectivity and adjacency of features
Visioning – seeing the possibilities of "what can be" and inspiring a shared sense of purpose within the organization

TABLE 3
Geospatial Technology Core Competencies
(Note: Core competencies are shown in bold)

Technical Competencies	Business Competencies
Ability to Assess Relationships Among Geospatial Technologies	**Ability to See the "Big Picture"**
Cartography	Business Understanding
Computer Programming Skills	Buy-in/Advocacy
Environmental Applications	**Change Management**
GIS Theory and Applications	**Cost Benefit Analysis/ROI**
Geology Applications	Ethics Modeling
Geospatial Data Processing Tools	Industry Understanding
Photogrammetry	Legal Understanding
Remote Sensing Theory and Applications	Organization Understanding
Spatial Information Processing	Performance Analysis and Evaluation
Technical Writing	**Visioning**
Technological Literacy	
Topology	
Analytical Competencies	**Interpersonal Competencies**
Creative Thinking	Coaching
Knowledge Management:	**Communication**
Model Building Skills	Conflict Management:
Problem-Solving Skills	**Feedback Skills**
Research Skill	Group Process Understanding
Systems Thinking	**Leadership Skills**
	Questioning
	Relationship Building Skills
	Self-Knowledge/Self-Management

for the geospatial industry. The competency model provides a baseline from which to build as the industry continues to evolve. One criticism of competency assessments is how accurate and comprehensive they are no matter how carefully developed. Inevitably, there were intangible and unmeasured components of every role required that were not captured. Those familiar only with traditional job and task analyses and unfamiliar with using competency-based performance approaches will more than likely misunderstand the intent and purpose of the Competency Model if time and effort is not made to understand workforce planning processes. Finally, the breadth and depth of end-user applications for geospatial technologies continues to expand. While the researchers developed an intentional focus on a limited number of end-user applications–albeit the most widely used applications at the time–there are now 12 defined federal applications for geospatial technologies (http://esnetwork.org) that would provide a more comprehensive framework for study.

The participation from industry, governmental, and educational community representatives was key to this research initiative. These partnerships are consistent with NASA's commitment to create a customer/industry driven model and to utilize existing resources to create systemic change in the way students and the incumbent workforce are trained and retrained.

Current efforts are underway to make an online tool available as a self-assessment to determine an individual's key role of interest or practice for the geospatial industry. The results of the assessment will provide a framework for an individual's career development. An additional use of the tool is to help human resource managers find and retain geospatial professionals. The GTCM online assessment tool will be available at http://geowdc.info. Researchers are also developing partnerships with other federal agencies to integrate the GTCM with the existing workforce development infrastructure. The value of the Geospatial Technology Competency Model will ultimately be measured by its implementation as a tool for performance management, employee recruitment and selection, career development, and as a curriculum framework for training and education.

Table 4
Geospatial Technology Competency Model©

			ROLES											
			Applications Development	Coordination	Data Acquisition	Data Analysis	Data Management	Management	Marketing	Project Management	Systems Analysis	Systems Management	Training	Visualization
COMPETENCIES	Technical	Ability to Assess Relationships Among Geospatial Technologies		●				●	●		●	●	●	●
		Cartography			●	●								●
		Computer Programming Skills	●		●		●				●			●
		Environmental Applications	●			●								●
		GIS Theory and Applications	●			●	●	●		●		●	●	●
		Geology Applications				●								
		Geospatial Data Processing Tools			●	●					●	●	●	●
		Photogrammetry	●		●	●								●
		Remote Sensing Theory and Applications	●		●	●						●		●
		Spatial Information Processing	●		●	●							●	●
		Technical Writing	●	●		●		●	●	●	●	●	●	●
		Technological Literacy	●		●	●	●	●		●	●	●	●	●
		Topology				●								●
	Business	Ability to see the "Big Picture"	●	●			●	●	●		●	●	●	
		Business Understanding		●				●		●				
		Buy-in/Advocacy		●				●	●		●		●	●
		Change Management	●	●		●	●	●	●	●	●	●	●	●
		Cost Benefit Analysis / ROI		●			●	●	●	●		●	●	●
		Ethics Modeling				●		●	●	●		●	●	●
		Industry Understanding	●	●				●	●				●	●
		Legal Understanding		●										
		Organization Understanding		●				●				●		
		Performance Analysis and Evaluation			●			●		●	●	●	●	
		Visioning		●				●	●	●	●	●	●	
	Analytical	Creative Thinking	●	●	●	●	●	●	●	●	●	●	●	●
		Knowledge Management		●		●		●		●		●	●	●
		Model Building Skills	●				●	●				●	●	●
		Problem-Solving Skills	●	●	●	●	●	●	●	●	●	●	●	●
		Research Skill	●			●							●	
		Systems Thinking	●					●			●	●	●	●
	Interpersonal	Coaching		●				●					●	
		Communication	●	●	●	●	●	●	●	●	●	●	●	●
		Conflict Management		●				●		●		●	●	
		Feedback Skills	●	●	●	●	●	●	●	●	●	●	●	●
		Group Process Understanding		●				●		●		●	●	
		Leadership Skills		●			●	●	●	●		●	●	●
		Questioning		●				●	●		●	●	●	
		Relationship Building Skills		●				●	●	●	●	●	●	
		Self-Knowledge/Self-Management		●				●	●		●	●	●	

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