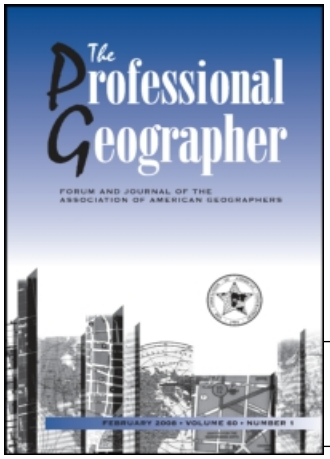

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Skills in Professional Geography: An Assessment of Workforce Needs and Expectations

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Skills in Professional Geography: An Assessment of Workforce Needs and Expectations*

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This study compares the skills of professional geographers and the needs of employer organizations across major sectors of the U.S. workforce. Following a series of focus groups, two surveys were developed to explore: (1) the extent to which specific skills were performed by geographers in different professional positions, and (2) the value of and anticipated demand for those skills from the perspective of employers. Overall, respondents in the focus groups and both surveys emphasized the need for general skills ranging from time management and writing ability to information management and computer literacy. Employers also cited many geographic skills as being vital for enhancing the work of professionals in all types of organizations. Competency in field methods, the ability to work across disciplinary boundaries, and spatial thinking were three skill areas that characterized the work of geographic professionals irrespective of specialty. **Key Words: competency model, geography workforce, professional development, skills.**

这项研究比较了专业地理学家的技能和美国劳动力主要行业的雇主组织之需要。经过了一系列专题小组讨论之后，我们利用了两个问卷调查来分别探讨：(1) 在何种程度上地理学家会在不同专业岗位表现出特殊技能，以及(2) 雇主对这些技能的价值评价和预期需要。总体而言，小组讨论的受访者以及两项调查都强调了对例如时间管理，写作能力，信息管理和电脑知识等一般技能的需要。雇主也指出许多地理技能对于提升在各类型组织的专业人士的工作素质有着重大的影响。无论什么专业，地理学专业人士的工作特点包含了善长野外考察，跨学科的工作能力以及拥有空间思维三大技能领域。**关键词：胜任素质模型，地理界劳动力，专业发展，技能。**

En este estudio se comparan las destrezas de los geógrafos profesionales y las necesidades de las organizaciones de empleadores entre los principales sectores de la fuerza laboral de Estados Unidos. Después de realizar una serie de grupos de enfoque, se desarrollaron dos encuestas para determinar: (1) el grado al cual los geógrafos desempeñaron destrezas específicas en diferentes posiciones profesionales, y (2) el valor de esas destrezas y su demanda anticipada desde la perspectiva de los empleadores. En general, las personas que participaron en los grupos de enfoque y en ambas encuestas enfatizaron la necesidad de destrezas generales que variaron, desde el manejo del tiempo y habilidad para redactar, hasta la administración de la información y conocimientos de computación. Los empleadores también citaron como vitales muchas destrezas geográficas debido a que mejoran el trabajo de los profesionales en todo tipo de organizaciones. La competencia en los métodos de campo, la capacidad de cruzar los límites de otras disciplinas y un razonamiento espacial, fueron las tres áreas de destrezas que caracterizaron el trabajo de los profesionales geográficos independientemente de su especialidad. **Palabras claves: modelo de competencia, fuerza laboral geográfica, desarrollo profesional, destrezas.**

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To prepare today's students for tomorrow's workforce, the challenge for geography educators is one of connecting disciplinary instruction with more general training that yields marketable and valued skills in the modern workplace (Hill 1995; Richardson and Solís 2004). Some academic departments have addressed this challenge by initiating professional master's degree programs in the sciences that integrate management training and internships with scientific education (Tobias, Chibin, and Aylesworth 1995; Council of Graduate Schools 2007). Examples of professional master's programs in geography include those at Arizona State University and Penn State University.

In an era when many national organizations are advocating widespread reforms aimed at changing approaches to professional development in academic degree programs (Nyquist and Woodford 2000; Golde and Dore 2004), many geography departments are hearing from students who are curious about career options and the value of a geography degree for employment within and beyond the academy. This interest also comes at a time when geography is experiencing unprecedented growth within higher education as well as in society more generally (even though it remains a midsized discipline compared to other social and environmental fields). As evidence of this growth, consider the following trends since 2000:

- Undergraduate degrees in geography at U.S. institutions of higher education grew by about 66 percent (from approximately 2,900 to 4,800) between 1987–1988 and 2003–2004. During that same time period, master's degrees in geography grew by about 33 percent (from approximately 580 to 770) and doctoral degrees grew by about 33 percent (from approximately 150 to 200). These rates of growth outpace those of most other disciplines (Pandit 2004; Murphy 2007).
- In the five-year period between 1999–2000 and 2004–2005, the size of the tenure-track faculty in geography departments offering degrees through the PhD grew by 8 percent (from 721 to 780). Similarly, the same institutions witnessed growth in undergraduate majors (up 12 percent from 4,552 to 5,094), master's students (up 14 percent from 1,120 to 1,279), and PhD students (up nearly 11 percent from 1,076 to 1,191). Liberal arts and comprehensive institutions also experienced growth in geography faculty and student populations during this period (Murphy 2007).
- Geography is experiencing a resurgence as an academic discipline for tackling issues of local, national, and global significance by attracting scholars drawn to its conceptual frameworks for interdisciplinary and integrative research (Pfirman and the AC-ERE 2003).
- The number of high school students taking Advanced Placement Human Geography grew from 3,272 in 2002 to 28,239 in 2007 (Murphy 2007).
- In 2004 the U.S. Department of Labor released a statement highlighting geospatial technology as one of the most important emerging and evolving fields in the technology industry (Gewin 2004).

Despite this well-documented growth in the discipline, national-scale data on career patterns in geography remain scarce, especially for professional positions outside the academy (Gedye, Fender, and Chalkey 2004; Solem and Foote forthcoming). This information is needed for several reasons. First, it demonstrates the value of an academic degree in geography for students, parents, academic advisors, policymakers, and the public. Second, it illustrates the ways that geographical knowledge and skills contribute to the work of individuals and organizations in a wide range of professional settings. Better data on the types, numbers, and categories of jobs held by geography graduates enhances career planning by clarifying the courses and educational experiences required for preparation in a particular field or industry. This information, in turn, will shed light on the differences in professional cultures in employer organizations across higher education, government, and the private sector.

This study assesses the nature of the work performed by geography graduates and the value of their skills and abilities for employment in a variety of professions. With input from recent alumni of graduate programs and more experienced employees representing small, medium, and large employer organizations, we developed a model classifying different types of skills required for effective

performance in geographic careers. This competency model for professional geography includes both discipline-based skills, such as the ability to apply knowledge of biogeography or analyze spatial patterns on an aerial photograph, and more general skill areas related to communication, technology, and management. The competency model was subsequently used to develop two surveys aimed at estimating the current and future need for particular skills from the perspective of a sample of professional geographers and their employers.

A competency model such as the one reported in this study does not explain how professional expertise in a discipline develops through a formal program of education (cf. Downs 1994). Rather, it provides a valid set of concepts for categorizing and assessing the skills of professionals in a particular field or industry. Aside from a competency model developed for the geospatial technology industry (Gaudet, Annulis, and Carr 2003) and a book outlining key concepts and skills in geographic information science (DiBiase et al. 2006), researchers have yet to produce a comprehensive model portraying the overall professional skills expected of individuals hired to do geographic work. In recent years, however, a number of studies by geographers in the United States and the United Kingdom have addressed the issue of "employability" and relationships between the abilities of geography graduates, on the one hand, and the skills that employers are seeking, on the other hand (Mistry, White, and Berardi 2006; Solem et al. 2006; Donert 2007). This literature contributes to this study in two important ways. First, it provides a starting point for creating an inventory of skill areas that are required for successful job performance in geographic career fields. Second, it establishes a basis for comparing relationships between education and employability, workplace cultures and environments, and key issues facing the industries and organizations that hire professional geographers.

In this article, we report on the methodology that was used to develop and validate a competency model for professional geography. Using the skill areas defined in the model, we then assess how geographic and general skill areas are applied in the professional work of geographers in different workplace environments. Next, we assess the likely demand for those skills based on employer evaluations of workforce and industry trends. We conclude by discussing the implications of our findings for professional development and career advising in academic geography programs.

Methodology

The skill areas in our competency model were developed through a multiphase methodology spanning several months. First, we convened an advisory committee of fifteen geographers holding administrative and managerial positions in higher education, government, and the private sector. The committee members were selected from a group of advisors on existing Association of American Geographers (AAG) educational projects as well as the membership of AAG committees related to geography education and careers. Their academic backgrounds encompassed physical geography, human geography, and geographic information science.

The advisory committee assisted us in defining the parameters of professional geography, which quickly proved to be a challenging and elusive undertaking. Given the multiple definitions and conceptual frameworks that the committee members had of geography, the diverse array of occupations requiring geographic skills, and the highly interdisciplinary nature of the discipline itself, we quickly realized that the skills characterizing the work of professional geographers would likely vary significantly across major sectors of employment. This situation was compounded by the fact that, unlike the learning outcomes for K–12 teaching and learning in the national geography standards (Geography Education Standards Project 1994), or the benchmark statement for geography in the U.K. higher education system (Chalkley and Craig 2000), there is no general consensus among American academics or employers over what geography graduates should know and be able to do.

Rather than attempt a definitive statement of professional competency or educational outcomes, we decided to take a less ambitious yet essential step toward identifying the skill areas that provide an adequate foundation of professional competency for individuals seeking employment in geographic career fields. We worked with the advisory committee to

search the Department of Labor's online Occupational Information Network (O*NET) database for examples of careers likely to require some professional preparation in geography for an entry-level position. A search of the O*NET database of occupational information (U.S. Department of Labor 2007) produced a list of 145 occupations indexed to keywords such as geography, geospatial, GIS, and spatial analysis.

This list of geographic occupations served as a point of reference for the development of an interview protocol used with focus groups convening at the AAG central office in Washington, DC, in August and September 2005. The focus groups were questioned with the aim of better understanding the workplace issues, needs, and trends that may have implications for the professional development of individuals holding the same (or similar) type of occupations as those on our list. Specifically, we wanted to know the following:

1. What kinds of knowledge and skills, geographic as well as general, are needed in your industry, organization, or agency? How does this need vary for individuals in different roles and positions of responsibility?
2. From your perspective, are undergraduate and graduate geography programs producing workers with the competencies required for success in your industry, organization, or agency? What are these programs doing well in terms of career preparation? What needs are not being satisfied?
3. Looking toward the future, to what extent do you anticipate changes in your industry, organization, or agency in the coming decade? How might these changes affect hiring decisions and the need for geographically competent workers?

Participants in the focus groups were drawn from the AAG membership database and selected to represent a balance of private companies, government agencies, and higher education institutions. The majority of the participants came from the Washington, DC metro area, and others participated at a distance via teleconference. Individuals were invited to participate on the basis of being employed in companies, agencies, and educational organizations that have provided internships or hired geography graduates in the previous year; on the basis of being corporate or institutional members of the AAG; and on the basis of recommendation from the project advisors. Invitations were sent to 306 individuals, and a total of fifty (ten women, forty men) agreed to participate.

With regard to workforce sectors, fifteen participants held positions in government, seventeen participants worked in the private sector (both for-profit and nonprofit organizations), and eighteen participants were employed as faculty members in academic geography departments. Experience levels ranged from early-career professionals with less than five years of experience to more senior professionals holding supervisory positions as chairs of departments, senior research analysts, executive managers, vice presidents, senior advisors, and chiefs of operation.

The size of the focus groups, eight in total, varied between three and eight participants. After analyzing the data from these focus groups, and following further discussion with the project advisors, we were satisfied that the data set provided sufficient coverage of major issues related to professional development in geography. The following is a summary of the themes emerging from the focus groups.

Results of Focus Groups

Although opinions varied, participants across all of the workforce sectors shared the view that analytical perspectives such as spatial thinking, as opposed to highly specialized theoretical or factual knowledge in a geographic subfield, have the broadest utility in the professional workforce. The importance of spatial thinking was highlighted in a variety of ways. One participant explained that individuals need to be able to "think geographically, not just technically." Echoing this theme, another participant noted that people "need a fundamental grounding in good ol' Geography 101"; that is, preparation in fundamental geographic concepts and methods of analysis. They argued that, although many people can learn to use geographic information systems (GIS) and other mapping technologies, employees also need to be able to determine the accuracy of data through field verification, and understand what forms of spatial analysis are appropriate for particular questions.

Some of the participants suggested that there are patterns in the relative importance of geographic skills in different employment sectors. Individuals representing the federal government, for example, cited traditional training in geography, such as education in a thematic specialty (e.g., political geography, biogeography, economic geography) and training in a regional specialty (e.g., Europe, Middle East, East Asia) as providing valuable preparation for many agency positions, which are often organized according to a regional framework. Besides a general background in geography and the ability to think spatially, individuals from higher education institutions emphasized the need for new faculty to acquire teaching experience as early as possible, ideally beginning in graduate school. Similar to the views of the federal government representatives, those in the higher education workforce sector, primarily at research institutions, noted the desirability of having specialized knowledge in a geographic research subfield.

Participants from private for-profit industries also emphasized spatial thinking as an essential skill for work in their organizations. Geographers are not the only employees in their businesses, but they noted that geographers need to be prepared with GIS, cartography, spatial analysis, programming, data management, and quantitative skills. Participants from nonprofit organizations agreed that these are also important skills for geographers in their organizations, but they introduced several other examples as well, such as the ability to conduct fieldwork and place-based research, because many projects require individuals to utilize a broad range of geographic skills simultaneously. A representative of a nonprofit organization in Colorado explained,

> We are looking for people who are able to think across local and global scales as well as at long temporal resolutions. Geographers are used to being able to think across multiple scales and nest spatial scales together.

At times, it is important for employees of these organizations to possess a regional specialty for projects that require more in-depth knowledge of particular places.

During several of the interviews, there were lengthy discussions regarding the utility of skills developed through fieldwork. One experienced geographer in the federal government referred to fieldwork as "muddy boots" training that affords individuals with the experiences necessary for developing an understanding of landscape dynamics when they can see firsthand what they are analyzing with a GIS or remote sensing imagery. A recent geography alumnus, however, said, "Field studies don't have the backing of my department because they require time and money." Yet, several people suggested that field skills can be potentially developed by any course in geography, even if it means only a few hours of data gathering in the local campus or neighborhood. Another professional geographer employed by the federal government emphasized the significance of field experiences by explaining that "the field methods course was one of the classes that helped me the most to understand how things relate to each other." Extending this idea, participants discussed the importance of linking the technical skills needed in many contemporary jobs to fieldwork and instruction in geography, a combination of experiences that work together to help produce a geographically competent professional possessing many other skills.

Having an interdisciplinary perspective and the ability to integrate knowledge across research fields was mentioned on several occasions as an important area of competency in professional geography. One participant observed that "most sciences in the twenty-first century realize that they have to be integrative," which prompted another participant to claim that geographers "are often trying to bridge the gap between applied science and more academic research, so communication becomes an important part of this . . . being able to speak all of those languages and bridge the different ideas and backgrounds of all of these different people." Several participants suggested that preparation in other disciplines, such as business or economics, along with a geography degree could be advantageous for some professional positions. Being knowledgeable of how world events are connected to local places was viewed as an important complement to this interdisciplinary perspective.

With regard to general nondisciplinary skills, the ability to communicate with diverse audiences was mentioned as being fundamentally important in many, if not most professional situations. One participant representing

a nonprofit organization noted, "People need to be able to speak to broad audiences and to distill a message for the general public, but also take it to researchers and have an intelligent discussion with them." Another individual added, "[employees] need to be able to write for a lay audience, such as for policymakers, and for outlets such as newspapers." Several participants were troubled by the inability of some employees to use computer software for making presentations and the lack of knowledge regarding proper citation methods in written communication. One professor suggested that professional development courses for undergraduate and graduate students should be offered more widely to provide practice in oral, graphic, and written forms of communication.

Also quite important to participants in all of the workforce sectors was for employees to understand how organizations function. They suggested that employees need to understand not only the general hierarchy and bureaucracy of their organizations, but also their roles within the organization. A related trait is having a vision and commitment to improving the overall mission of the organization, while adopting a collegial approach to working with colleagues and in teams. As one professor noted, employers want people who can "come up with ideas, contribute and lead [an organization] into the future."

Survey Development

Using the focus group results, and with input from the project advisors, we identified and defined a set of geographic and general skill areas for professional geography. Because we sought to take an inclusive approach with our model to portray the diversity of work undertaken by professional geographers, we included a range of skills, from those that were mentioned only a few times to skills that were cited on multiple occasions during the deliberations of the focus groups. We adapted many skill definitions from a competency model for the geospatial technology industry (Gaudet, Annulis, and Carr 2003), bringing the total number of skill areas in our study to forty-nine.

The set of forty-nine skill areas was subsequently used to design two surveys:

1. The first survey, which we refer to as the alumni survey, was designed to acquire data on how geographic and general skills are applied in the work of geography graduates in different professional positions. It was sent to a sample of 2,590 individuals, all of whom received an undergraduate or graduate degree in geography between the years 2000 and 2005.
2. The second survey, which we term the employer survey, focused on estimating the current and future demand for geographic and general skills in four major workforce sectors (higher education, government, nonprofits, and for-profit private organizations). It was sent to a sample of 3,427 individuals known to have been employed at their institution for at least five years since their terminal degree.

The samples for both surveys were constructed from a database of AAG member and nonmember contacts. Only U.S. residents were included in the study.

Prior to implementation, both surveys were piloted with twenty-five individuals randomly drawn from the sampling frames. The pilot surveys were used to acquire feedback on the content and overall design of the survey, which led us to simplify some of the instructions for completing the survey and add some questions on topics that the respondents felt were not addressed in sufficient detail (e.g., the importance of on-the-job training for learning new skills). Tables 1 and 2 present the list of geographic and general skill areas as they appeared in the final versions of the surveys.

The alumni and employer surveys were sent using a Web-based form to the full samples in three separate mailings (an initial invitation and two reminders) between April and June 2006. The alumni survey received 280 complete returns, whereas the employer survey netted 447 complete returns (for response rates of 11 percent and 13 percent, respectively). In survey research designed to produce inferences about a population based on the characteristics of a randomly drawn sample, low response rates such as these can be problematic. Because the objective of this study was to conduct a comparative analysis of the skill backgrounds and needs of subgroups of respondents (employer organizations and professional geographers) in

Table 1 *Geographic skill areas in professional geography*

1. **Geomorphology**
   Knowing and applying geographic information about geology and the processes that shape physical landscapes (e.g., soils, hydrology, topography, erosion)
2. **Weather and climate**
   Knowing and applying geographic information about weather, climate, and atmospheric processes (e.g., temperature, precipitation, air quality)
3. **Biogeography**
   Knowing and applying geographic information about ecosystems and ecological processes (e.g., vegetation, wildlife, natural habitats)
4. **Natural hazards**
   Knowing and applying geographic information about natural hazards (e.g., hurricanes, floods, earthquakes, fire)
5. **Economic geography**
   Knowing and applying geographic information about the economy and economic processes (e.g., labor, development, industry, agriculture, transportation, trade, resources, land use, technology change)
6. **Political geography**
   Knowing and applying geographic information about political systems and processes (e.g., governments, political activism, nongovernmental organizations, nations, states, international relations, nationalism)
7. **Cultural geography**
   Knowing and applying geographic information about culture and cultural processes (e.g., religion, language, ethnicity, diffusion, meaning of landscapes, cultural significance of place)
8. **Population geography**
   Knowing and applying geographic information about population, demography, and demographic processes (e.g., population density, migration, birth and death rates, fertility rates)
9. **Human–environment interaction**
   Knowing and applying geographic information about relationships between nature and society (e.g., pollution from industrial development, economic effects of drought)
10. **Cartography**
    Designing paper or digital maps
11. **Geographic information systems (GIS)** Using GIS to acquire, manage, display, and analyze spatial data in digital form
12. **Photogrammetry**[a]
    Recording, measuring, and plotting electromagnetic radiation data from aerial photographs and remote sensing systems against land features identified in ground control surveys, generally to produce planimetric, topographic, and contour maps
13. **Remote sensing**[a]
    Understanding the underlying theories and methods related to acquiring an object without contacting it physically (e.g., aerial photography, radar, and satellite imaging)
14. **Field methods**
    Using interviews, questionnaires, observations, photography, maps, and other techniques for measuring geographic information in the field
15. **Spatial statistics**
    Using quantitative methods to process spatial data for the purpose of making calculations, models, and inferences about space, spatial patterns, and spatial relationships
16. **Regional geography**
    Possessing and applying knowledge of the physical and human geography of a specific country or world region
17. **Interdisciplinary perspective**
    Drawing on and synthesizing the information, concepts, and methods of the natural and social sciences for geographic research and applications
18. **Spatial thinking**
    Identifying, explaining, and finding meaning in spatial patterns and relationships (e.g., site conditions, how places are similar and different, the influence of a land feature on its neighbors, the nature of transitions between places, how places are linked at local, regional, and/or global scales)
19. **Global perspective**
    Possessing and applying knowledge of how people, places, and regions are linked by global networks and processes (e.g., globalization, international trade, immigration, Internet technology, global climate system)
20. **Diversity perspective**
    Using knowledge about population diversity (e.g., gender, ethnicity, race, sexuality, disability) to interpret social, economic, and political issues in different places

[a] *Concepts and definitions adapted from Gaudet, Annulis, and Carr (2003).*

different workforce sectors, the return rate for both surveys generated an amount of data sufficient to support almost all of the desired analyses. An exception was the relatively low number of nonprofit organizations represented in the sample for the employer survey, a situation that prevented us from making some assessments of skill needs in that sector as noted later.

By employment category, the distribution of returns for both surveys was greatest for higher education, followed by government agencies (federal, state, and local), for-profit companies, and nonprofit organizations. The proportion of respondents in the higher education and government sectors, however, is comparably lower and higher, respectively, than that of the known employer affiliations of individuals in the AAG

Table 2 *General skill areas in professional geography*

1. **Public speaking** Giving oral presentations, briefings, or speeches for general or expert audiences
2. **Writing** Communicating in written form for general or expert audiences
3. **Foreign (non-English) language skills** Reading, speaking, and/or writing in a language other than English
4. **Visual presentations** Preparing graphic presentations (e.g., pictures, images, slides) for general or expert audiences
5. **Creative thinking**[a] Recognizing, exploring, and using a broad range of ideas and practices
6. **Critical thinking** Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to a problem
7. **Problem solving**[a] Ability to consider alternative courses of action and select and implement appropriate solutions
8. **Research planning and design** Applying scientific procedures for an investigation or inquiry, such as an experiment, case study, survey, or field study
9. **Qualitative skills** Analyzing verbal, written, and other forms of nonnumerical data (e.g., interviewing, participant observation, ethnography, content analysis)
10. **Quantitative skills** Analyzing numerical or statistical data
11. **Professional and organizational culture** Demonstrating awareness of the vision, strategy, goals, and culture of a profession and professional organization
12. **Visioning**[a] Seeing the possibilities of "what can be" and inspiring a shared sense of purpose within the organization
13. **Supervising** Managing, directing, and overseeing the work of subordinates
14. **Entrepreneurial skills** Using business skills to promote organizational growth, innovation, and development
15. **Teamwork** Working as a member of a team and fulfilling group, individual, and work needs
16. **Coaching and advising**[a] Helping individuals recognize and understand personal needs, values, problems, alternatives, and goals
17. **Relationship building skills**[a] Establishing relationships and networks across a broad range of people and groups
18. **Intercultural skills** Interacting effectively and respectfully with individuals with different cultural backgrounds
19. **Teaching** Applying effective instructional materials and methods for K–12, college, or professional education
20. **Computer and technology skills**[a] Understanding and appropriately applying existing, new, or emerging technologies
21. **Publishing** Preparing manuscripts, books, articles, columns, and other communications for publication in print or digital form
22. **Information management** Retrieve and organize information from a variety of sources
23. **Grant proposals** Writing proposals to obtain funding for research, education, equipment, tuition, or other expenses
24. **Time management** Working efficiently on multiple tasks
25. **Adaptability** Adapting to change in the workplace and profession
26. **Self-awareness** Monitoring and assessing the quality of one's own performance
27. **Ethical practice**[a] Demonstrating exemplary ethical behavior and understanding the implications of this responsibility
28. **Project management** Organizing, administering, and supervising projects
29. **Fiscal management** Applying financial skills such as accounting, preparing budget reports, and tracking expenditures

[a] *Concepts and definitions adapted from Gaudet, Annulis, and Carr (2003).*

contact database (Table 3). Although the AAG contact database is not a proxy for the universal population of professional geographers, it does provide some basis for determining the nature of the samples analyzed in this study; as such, it appears that we were most successful at generating a higher rate of responses from the government sector than we managed for the other three sectors.

The job titles of respondents to the alumni survey reveal a range of professional positions, concentrated at the top end by academic geographers and GIS specialists (Table 4). Respon-

Table 3 *Distribution of alumni and employer survey returns by sector compared to Association of American Geographers database of member and nonmember contacts*

Sector	Alumni ($N = 280$)	Employer ($N = 447$)	AAG contact database ($N = 4{,}996$)
Higher education	52%	52%	68%
Government	22%	30%	14%
For-profit company	17%	15%	13%
Nonprofit organization	4%	3%	2%
Unclassified	5%	0%	3%

Table 4 *Top twenty-five job titles of alumni survey respondents*

Job title	*N*
Professor (assistant, associate, or full)	89
Geographic information systems analyst/specialist/manager	30
Graduate assistant	24
Instructor	12
Geographer	8
Planner	8
Director	7
Technician	7
Analyst	6
Coordinator	6
Lecturer	6
Manager	6
Research assistant	6
Teacher	6
Research associate	4
Scientist	4
Cartographer	3
Consultant	3
Environmental scientist	3
Postdoctoral fellow	3
Project manager	3
Research scientist	3
Academic advisor	2
Chairperson	2
Inspector	2

dents to the employer survey, meanwhile, represent a range of large and small organizations across the major employment sectors (Table 5). Because the employer survey required individuals to answer questions on behalf of the employer organization, we advised respondents to seek assistance from individuals in the organization who may have more detailed or specialized knowledge of the organization's needs and culture. Although larger organizations such as major federal agencies or research universities were often represented by more than one respondent, the survey asked respondents to answer on the basis of their knowledge of local conditions and issues at the departmental or division level where they were employed within the organization. The results, therefore, reflect the diversity of workplace environments both within organizations and across major sectors of employment.

Results

Classification of Geographical and General Skill Areas

To compare how frequently the forty-nine skill areas were used in the work of professional geographers, we asked the alumni survey respondents to distinguish between three degrees of application: skill areas that they (1) always/very often need to perform, (2) sometimes need to perform, and (3) rarely/never need to perform. We assigned a numeric code to each level of frequency and then performed a factor analysis with varimax rotation on the full coded data set for the alumni sample. The factor analysis served two important objectives: (1) to explore conceptual relationships among the forty-nine skill areas, and (2) to validate the skill areas as constructs for assessing the work of professional geographers. This analysis produced twelve factors with corresponding individual variable loadings of at least 0.4 (Table 6). The twelve factors account for 65.9 percent of the variance in the data, with thirty-eight of forty-nine skill areas loading onto the first six factors (47.2 percent of the variance), each with a minimum of three skill areas. Eleven skill areas were scattered alone or in pairs over the remaining five factors, accounting for 18.7 percent of the variance.

On inspection, the six primary factors differentiate geographic from general skill areas, while also illustrating how some geographic and general skill areas "interact" in the work

Table 5 *Number of individuals employed in organizations responding to the employer survey by sector*

Sector	Self-Employed	2 to 20	21 to 100	101 to 500	501 to 1,000	1,001 to 5,000	>5,000	Total	% of total
Government		15	24	35	15	31	11	131	29.3
Nonprofit	1	6	1	2	1	2	2	15	3.4
For profit	13	14	9	15	3	7	5	66	14.8
Education		23	21	29	46	71	45	235	52.5
Total	14	58	55	81	65	111	63	447	
% of total	3.1	13.0	12.3	18.1	14.5	24.8	14.2		

Table 6 *Validated factors with percentage variance explained for the professional geography competency model (individual factor loadings are listed next to each skill area)*

Geographic skill areas	General skill areas
Human geography factor (10.9%)	Research, communication, and writing factor (9.0%)
Cultural geography (0.786)	Publishing (0.771)
Political geography (0.772)	Grant proposals (0.745)
Economic geography (0.738)	Visual presentation skills (0.644)
Diversity perspective (0.738)	Research planning and design (0.638)
Population geography (0.663)	Writing skills (0.555)
Global perspective (0.662)	Public speaking skills (0.509)
Regional geography (0.562)	Quantitative skills (0.488)
Spatial thinking (0.422)	Interdisciplinary perspective (0.4)
Intercultural skills (0.498)	
Qualitative skills (0.467)	
Physical geography factor (7.8%)	Administrative and leadership abilities factor (7.0%)
Biogeography (0.822)	Visioning (0.789)
Geomorphology (0.817)	Professional and organizational culture (0.757)
Weather and climate (0.791)	Entrepreneurial skills (0.606)
Natural hazards (0.629)	Supervising (0.586)
Human–environmental interaction (0.569)	Project management (0.479)
	Coaching and advising (0.416)
Geographic information science and technology factor (6.6%)	General cognitive abilities factor (5.8%)
Geographic information systems (0.833)	Problem-solving skills (0.779)
Cartography (0.763)	Critical thinking (0.717)
Spatial statistics (0.676)	Creative thinking (0.659)
Remote sensing (0.574)	
Photogrammetry (0.479)	

Note: Skill areas on remaining six factors (collectively 18.7 percent of the variance): self-awareness, ethical practice, information management, teamwork, adaptability, relationship-building skills, teaching and training, grant proposals, fiscal management, entrepreneurial skills, and foreign language skills. Field methods had loadings of 0.363 on the research, communication, and writing factor and 0.329 on the physical geography factor. Spatial thinking had loadings of 0.307 on the geographic information science and technology factor and 0.415 on the research, communication, and writing factor. Interdisciplinary perspective had a loading of 0.373 on the human geography factor.

of professional geographers (Table 7). Thus, the output of the factor analysis, which discriminates generally understood domains of geographic expertise, fits this study's operative definition of a competency model as being a framework for classifying the skill areas of a professional workforce.

Three of the emergent factors on the model relate to major domains of geographic expertise:

1. One factor consists of skill areas related to knowing, understanding, and applying concepts and methods in human geography, along with variables related to geographic perspectives and general analytical skills.
2. A second factor consists of variables related to knowing, understanding, and applying concepts and methods in physical geography. The human–environment interaction skill area also loaded highly on this factor.
3. A third factor consists of variables related to knowing, understanding, and applying concepts and methods in geographic information science and technology.

The factor analysis also produced three clusters of general skill areas, including the following:

1. A factor consisting of variables related to research, communication, and writing skills. One geographic skill area (interdisciplinary perspective) loaded highly on this factor.
2. A factor consisting of variables related to administrative and leadership abilities.
3. A factor consisting of variables related to general cognitive abilities.

A few geographic skill areas showed affinity for more than one factor. Field methods had modestly strong loadings on both the research,

Table 7 *Distribution (by percentage) of survey respondents who "always or very often" need to perform specific geographic and general skills*

Skill areas	Government	Higher education	Nonprofit company	For-profit company
Geography				
Weather and climate	21.3	**29.4**	16.7	**6.3**
Economic geography	31.1	**38.9**	**16.7**	20.8
Political geography	19.7	31.9	**33.3**	**18.8**
Cultural geography	**18.0**	47.6	**58.3**	20.8
Human–environmental interaction	43.5	54.9	**58.3**	**33.3**
Field methods	43.5	**61.8**	41.7	**37.5**
Regional geography	41.0	**50.0**	41.7	**35.4**
Interdisciplinary perspective	53.2	**79.9**	58.3	**37.5**
Spatial thinking	67.7	**83.3**	**50.0**	56.3
Global perspective	26.2	**61.5**	**25.0**	27.1
Diversity perspective	26.7	55.9	**63.6**	**22.9**
General				
Public speaking skills	74.2	**87.6**	66.7	39.6
Writing skills	80.6	**96.6**	91.7	**68.8**
Visual presentation skills	68.9	**92.4**	63.6	**62.5**
Creative thinking	72.1	**91.0**	83.3	**70.8**
Research planning and design	50.8	**80.0**	58.3	**50.0**
Visioning	41.9	**30.3**	**83.3**	52.1
Entrepreneurial skills	14.5	**12.6**	**58.3**	35.4
Teamwork	**85.5**	**58.6**	83.3	81.3
Coaching and advising	**33.9**	**52.8**	41.7	43.8
Teaching and training skills	38.7	**79.9**	33.3	**31.3**
Publishing	38.7	**70.8**	50.0	**20.8**
Grant proposals	16.1	55.6	**66.7**	**10.6**

Note: Boldface values indicate a higher than expected amount of responses, whereas shaded boldface values represent a lower than expected amount of responses. All boldface values are significant at $\alpha = 0.01$.

communication, and writing factor and physical geography factor. Likewise, spatial thinking had relatively strong loadings on the geographic information science and technology factor and research, communication, and writing factor. Interdisciplinary perspective also loaded appreciably on the human geography factor.

Applications of Skills in Professional Geography

To explore patterns of how frequently the respondents to the alumni survey apply their geographic and general skills, we ranked the forty-nine skill areas by the percentage of respondents who said they "always or very often" perform the skill (Figure 1). The results indicate that general skill areas are applied more frequently than any area of geographic skill. For example, skills related to communication, writing, critical thinking, and problem solving were cited by at least 75 percent of the respondents as skills they "always or very often" needed to perform, with time management topping the list. Among the geography skill areas cited, the main pattern is that analytical perspectives in geography were applied more often than specialized knowledge in subfields of physical and human geography. Spatial thinking—the skill ranked twelfth overall—was noted by 73.1 percent of respondents as a skill they "always or very

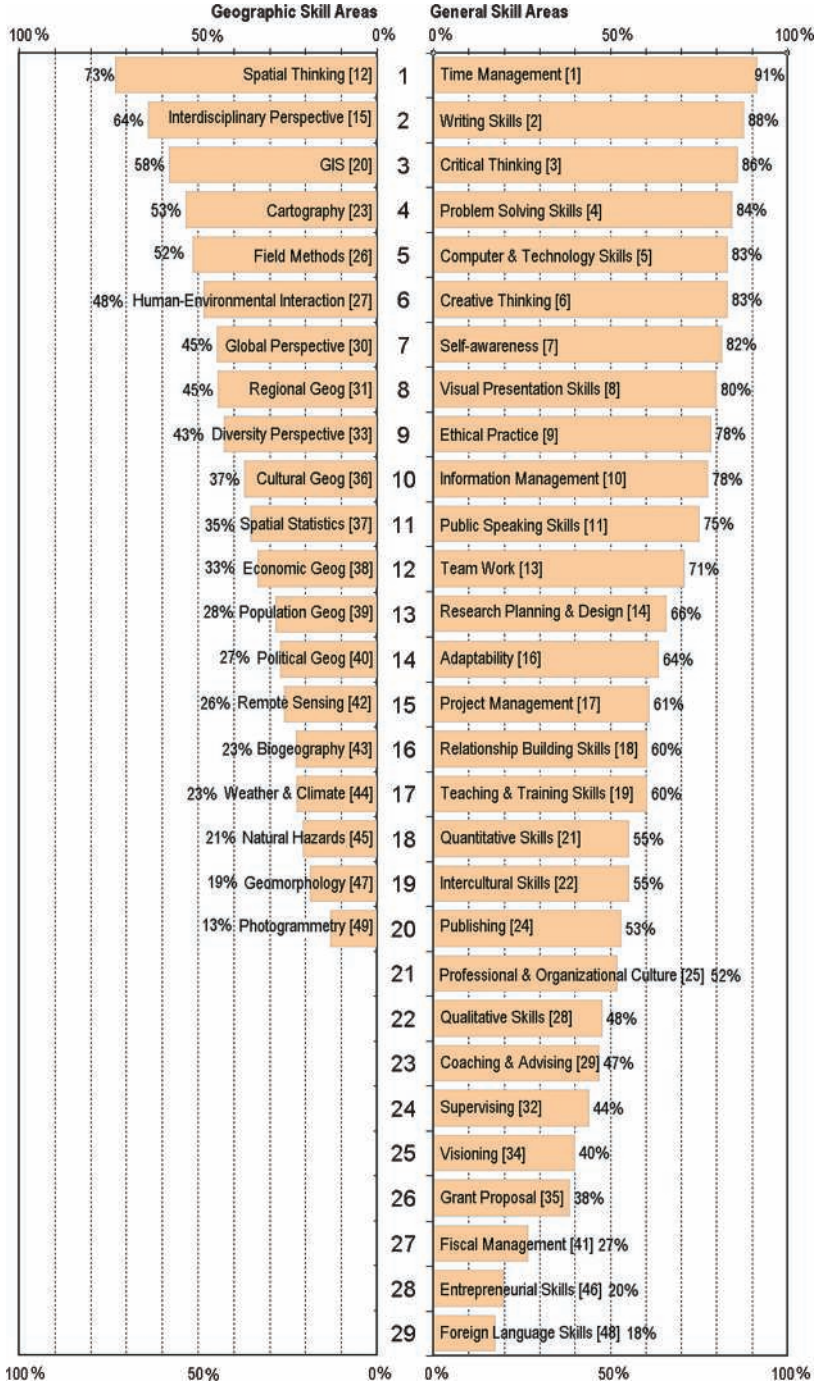

Figure 1 *Skill areas noted by geography alumni (N = 280) as ones they "always or very often" need to perform. Number in brackets signifies the overall ranking based on the percentage responding.*

often" perform, followed by interdisciplinary perspective, GIS, cartography, and field methods, all of which were cited by more than half of the respondents as skills they apply regularly.

Next, we compared these same responses across four major areas of employment: higher education, government, nonprofit organizations, and for-profit organizations. In light of our focus group findings, we wanted to explore whether particular skills were more frequently applied in the work of certain professionals, or more valued by certain types of employers. Chi-square tests of significance on the distribution of the "always or very often perform" responses reveal differences in the types of skills most frequently exercised by professional geographers working in different sectors (Table 7). For example, several geography skill areas (e.g., weather and climate, economic geography, field methods, regional geography, interdisciplinary perspective, spatial thinking, and global perspective) were more likely to be performed at a high level of frequency by professionals in higher education than in other sectors. Similarly, the skill areas of writing, visual presentation, critical thinking, and research planning were also more likely to be practiced in higher education workplaces, yet it is important to note that these skill areas are also relatively common to the work of professionals in for-profit and nonprofit organizations.

The skill areas of visioning, entrepreneurship, and teamwork were less likely to be applied in the work of higher education professionals. Teamwork, however, was particularly important to the work of government professionals, whereas visioning and entrepreneurship were relatively common in the work of professionals in the private sector.

Employer Demand for Skills

The employer survey asked respondents to review each skill area and indicate whether the ability to perform each was needed for the work of the organization at the departmental or division level (if applicable) where the employee worked. If the reply was affirmative (i.e., the skill is needed), the respondent was prompted to indicate whether the organization was experiencing overall success or failure in hiring workers able to perform the skill at the needed level of proficiency. Finally, the survey asked respondents to predict whether the organizational need for each skill area would increase, decrease, or remain at present levels over the next three to five years.

Across the government, nonprofit, and for-profit sectors of employment (Table 8), spatial thinking was cited by employers as being a relevant skill, yet one that is relatively difficult to find developed in the workforce. Skill areas such as interdisciplinary research, GIS, and cartography were also cited by employers in higher education, government, and the for-profit sector as areas in demand that have major relevance to the work of organizations across these sectors (Table 9). Employers also predict

Table 8 *Top five geographic and general skill areas in which employers are experiencing "some difficulty" or "failing" to meet their hiring needs*

Higher education	Government	For-profit company	Nonprofit company
		Geography skills	
• Spatial statistics • GIS • Field methods • Economic geography • Cartography	• Spatial statistics • Spatial thinking • Interdisciplinary perspective • GIS • Cartography	• Spatial thinking • Spatial statistics/GIS • Interdisciplinary perspective • Cartography	• Interdisciplinary perspective • Diversity perspective • Spatial statistics • Global perspective/regional geography/spatial thinking
		General skills	
• Grant proposals • Adaptability • Self-awareness • Visioning • Time management	• Visioning • Adaptability • Critical thinking • Problem solving/creative thinking/self-awareness	• Entrepreneurial skills • Time management • Creative thinking/critical thinking • Writing	• Research planning and design • Writing/supervising/entrepreneurial skills/professional and organizational culture

Note: GIS = geographic information systems.

Table 9 *Top five skill areas most frequently cited as needed for the work of employer organization (by sector)*

Higher education	Government	For-profit company	Nonprofit company
		Geography skills	
• Human–environment interaction • GIS • Global perspective • Cartography • Spatial thinking	• GIS Cartography • Spatial thinking • Spatial statistics • Field methods	• GIS • Cartography • Spatial thinking • Spatial statistics • Economic geography	• Interdisciplinary perspective • GIS • Cartography • Spatial thinking • Diversity perspective
		General skills	
• Critical thinking • Computer technology • Creative thinking • Quantitative skills • Problem solving	• Writing • Visual presentation • Ethical practice • Computer technology • Teamwork	• Adaptability • Self-awareness • Ethical practice • Project management • Teamwork	• Many tied responses (totals too low to separate for analysis)

Note: GIS = geographic information systems.

that the significance of these skills will continue to increase in the coming three to five years (Table 10).

There was less consistency among employers in their assessment of the general skill areas and related competencies of the workforce. Higher education employers, for example, are experiencing difficulty finding individuals skilled in grant proposal development, who can take on a lot of personal responsibility and autonomy, and who can manage time effectively while adapting to institutional change. Similar professional qualities are sought by government employers, who also report problems finding workers who are good problem solvers. In the private sector, entrepreneurship and good writing ability are highly desired qualifications, yet few professionals in the workforce are currently able to perform these skills well enough to satisfy these employers. According to the respondents, the need for these general skill areas for employer organizations will only grow in the near future.

Discussion

The competency model built from the alumni survey data illustrates how professional geographers perceive skill areas as being conceptually related: There was clear discrimination of

Table 10 *Top five skill areas most frequently cited by employers as most likely to increase in need over next three to five years (by sector)*

Higher education	Government	For-profit company	Nonprofit company
		Geography skills	
• Human–environment interaction • GIS • Global perspective • Interdisciplinary perspective • Remote sensing	• GIS • Cartography/spatial statistics • Spatial thinking • Interdisciplinary perspective	• GIS • Cartography • Spatial statistics • Spatial thinking • Economic geography	• GIS • Spatial statistics • Cartography • Remote sensing/ interdisciplinary perspective
		General skills	
• Grant proposals • Computer technology • Publishing • Time management • Information management	• Computer technology • Information management/critical thinking • Creative thinking/ problem solving	• Computer technology • Time management • Writing • Information management • Adaptability	• Many tied responses (totals too low to separate for analysis)

Note: GIS = geographic information systems.

skills related to physical geography, human geography, and geographic information science and technology. Although the factors represent distinct assemblages of geographic and general skills from the perspective of a sample of professional geographers, the nature of work in professional geography can involve simultaneous application of many types of skills. It is also true that a particular skill can be highly characteristic of work in many professions and workplaces. As constructs based on respondent perceptions, the model's factors only assess what professionals think is the nature of their work. Because no "objective" measure of competency in geography yet exists, the perceptions that professionals have of their skills and their work can provide a means of developing constructs that, in turn, can be used to assess the skills and work of others in a given field such as geography.

The results of this study reinforce what we learned from our focus groups with professional geographers and employer organizations: Above all, professionals need to be good managers, communicators, writers, and problem solvers. The value of specialized knowledge in geography, in contrast, often varies. A similar pattern was detected by Mistry, White, and Berardi (2006) in a study of the U.K. geography workforce. The British professionals agreed that skills related to communication, financial management, adaptability, working in teams, and the ability to acquire and analyze information were most commonly applied in their professional positions. Although the U.K. terminology for skills differs from that of this study, there does seem to be some commonality in workplace cultures and expectations for professional geographers in the United States.

An important pattern detected in our focus groups and surveys was that the ability to think spatially was a valued skill among the geographic professions, and one that is especially (but not exclusively) characteristic of work in human geography and geographic information science and technology subfields. As Lawson and Murphy (2007) note, "Any layer in a GIS (for example) involves decisions about data prioritization and spatial representation that are rooted in geographical principles and concepts, and often requires having an interdisciplinary perspective on relationships between human and environmental phenomena." The University Consortium of Geographic Information Science (UCGIS) "Body of Knowledge" report (DiBiase et al. 2006) also emphasizes the analytical concepts of space, scale, relative location, pattern, and spatial change as being foundational to effective use of geographic information technologies. Likewise, competency in field methods and the ability to integrate knowledge from multiple disciplines were related to the work of geographers in different fields of specialization. Such skills were pinpointed in the National Science Foundation report, *Complex Environmental Systems: Synthesis for Earth, Life, and Society in the 21st Century* (Pfirman and the AC-ERE 2003).This report presents a ten-year outlook for environmental research and education and argues for geographical and interdisciplinary methods to synthesize research questions and data acquisition across spatial, temporal, and societal scales.

Our focus group and survey findings also confirm that many geographic and general skills are in high demand, yet the curriculum offered by academic departments may not be producing those skills at a level required to satisfy that need. In the case of academic careers, Suckling (2000) showed that there were more open positions than new geography PhDs. Although graduate programs in geography are successfully preparing research specialists, there are many other areas in which new faculty are struggling once they begin their positions (Solem and Foote 2004). As is the case with other academic disciplines, geography graduates often complete their PhD without the sort of educational experiences that prepare them for the full range of professional responsibilities expected of faculty in higher education. Beyond the ability to teach and do research in a particular subfield of geography, respondents to the employer survey predicted a growing need for faculty who are skilled in computer technology, time and information management, publishing, and grant proposal writing.

Beyond the academy, there is ample evidence that the supply of graduates is not meeting the needs of employers. Academic programs in the social sciences including geography, for example, are not providing students with systematic guidance about the types of courses and educational experiences they need for careers in business, government, and the nonprofit sector (Nerad et al. 2007). Among federal agencies, the demand for geographically skilled workers

we observed in our study is reflected in a report by Gewin (2004), who noted that 26 percent of NASA's most highly trained "geotech" staff will retire in the next decade while the National Geospatial Intelligence Agency alone is expected to need 7,000 people trained in GIS during that period. Echoing this trend, a report by the Renewable Natural Resources Foundation discusses imminent retirements of large numbers of senior-grade personnel in federal agencies and private research firms, and the current lack of orientation in graduate science programs to prepare and encourage students to consider careers in these sectors (Colker and Day 2003). Although this situation presents a bright future for those who want to enter the geographic profession, it also poses significant challenges to education and training institutions and employer organizations seeking to bridge the gap between skills production and demand.

Although the results of this study may seem unsurprising in the wake of these published debates—employers want people who can write well, think critically, manage themselves and others, and so forth—perhaps the larger issue has to do with what the data suggest about the present culture of academic programs and how they are oriented, or not, to prepare graduates for employment. In this respect this study provides the sort of information that may be useful for a diverse group of stakeholders, including the following:

- Departmental committees charged with designing undergraduate and graduate curricula
- Parents and academic advisors helping students select majors and with career planning
- Employers making decisions about the types of professionals they need to hire
- Students who are selecting courses and programs of study with an eye toward a particular career

For all of these groups, knowledge of employer needs and expectations will clarify the right mix of academic preparation and job training (e.g., internships) that result in the development of employable skills. As accountability pressures mount for higher education institutions to document student learning outcomes, geography departments can benefit from empirical studies of the geography workforce to specify for their majors how academic geography coursework will equip them with necessary skills for employment. More and better data on the use of geographic skills in the workplace, in turn, will help with the recruitment and advising of students, simultaneously illustrating how geographic skills and technologies can enhance and perhaps reform the work of employer organizations. As one CEO commented in our focus groups,

> We need to be able to answer the question "Why should we hire a student with a degree in geography over a graduate from another discipline?" The answer needs to be clearly articulated for potential geography students, academic departments, employers, and the general public.

With regard to the "supplier" end of the skills continuum, we do not expect this study alone to trigger widespread, systemic change at the institutional or departmental level, but there is no reason why these sorts of career topics and professional development issues cannot be discussed as part of undergraduate or graduate advising and among faculty colleagues. As noted by Solem and Foote (2006), the recurrent desire expressed by the more than 500 geography faculty and graduate students who have participated in the Geography Faculty Development Alliance and other AAG career initiatives has been for more widely available information regarding academic and nonacademic professional career opportunities, and for a more systematic and comprehensive approach to professional development that equips individuals with skills, both disciplinary and general in nature, that are important in many career settings.

Toward that end, this study should be viewed as one component of a broader effort by the AAG to expand the amount of information available about career opportunities and professional development issues in geography. One practical resource emerging from this research is the AAG Online Career Guide and database (Association of American Geographers 2007) that provides a regularly updated system for tracking types, numbers, and categories of jobs in geography, with information on salaries, skill qualifications, and employment trends in academic, government, and private sectors.

As the revolution in geography and geospatial technologies gains momentum, the demand for geographic expertise will only continue to grow. Investment in geographical training and education is clearly of critical importance if the possibilities of the geographical renaissance are to be realized. In a survey conducted in collaboration with the Geospatial Information Technology Association, the AAG collected ideas from geographers in private companies, educational institutions, government agencies, and six nonprofit organizations for how to increase the supply of geographically competent workers (Geospatial Information and Technology Association and Association of American Geographers 2006). Many of their recommendations are salient for the professional geography workforce more generally and reinforce the implications of this study:

- Geography education needs to become much more prevalent at all levels and links need to be strengthened between related areas of study, such as engineering and the liberal arts, where geographical concepts and technologies are valued. The percentage of students enrolled in geography programs needs to be significantly increased through aggressive outreach campaigns and by building awareness of career opportunities in general.
- Geographical sciences and geospatial technologies must be embedded in core curricula of K–12 and higher education. The entire educational continuum (from K–12, community colleges, undergraduate and graduate programs, to lifelong continuing education) must be involved in this effort.
- Employers and educators must work together to develop effective strategies to close the gap between geographical workforce demand and supply. Employers must articulate their workforce needs to ensure that prospective workers understand what will be required of them. Two-year (community-based) colleges can assume a formative role in training new professional geographers and meeting on-the-job training needs of local professionals.
- Within social, behavioral, and economic sciences, there is not enough emphasis on the use of geospatial methods and techniques. There is a need for training in spatial analysis within the domains of statistics and quantitative analysis.

These recommendations are a starting point and we feel they offer promise to geography departments, aspiring professionals, and employer organizations seeking to maximize opportunities for future professional geographers.

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