

Geographic Information Systems (GIS) – An Emerging Skill in the Modern Workplace

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INTRODUCTION

Either directly or indirectly, almost every human activity has some kind of spatial or location-based component:

- Where is the meeting at?
- Where should the shopping center be located?
- Where is the best location to drill for oil?
- What areas should be set aside to protect the habitat of an endangered species?
- Where should the local sheriff schedule regular patrols in order to reduce recurring crime?
- How do I get there from here?
- Where is the vaccine needed most?¹

Geographic Information Systems (GIS) can be utilized to assist in the planning of nearly every activity listed above and more. GIS is a system of computer software, hardware, data, and personnel to help manipulate, analyze, and present information that is tied to a spatial location. At its simplest level, GIS can be thought of as a high-tech mapping tool, but the complicated software and the people who work with it are responsible for so much more than simply creating a map.

The value of GIS truly lies in the fact that any kind of information can be associated with location. The use of GIS can yield multiple sets of spatially-associated data so that complex questions that require multiple answers can be explored. As an example, in 2003 the New York Department of Transportation (DOT) needed to find a way to reduce congestion and traffic collisions along major routes without interfering with existing lines of public transportation. GIS enabled the New York DOT to create a layered map using spatial data that included existing road studies, high traffic areas, public transportation lines, and potential future roadways. The use of GIS greatly simplified an otherwise complex and costly process for the New York DOT.

1. "GIS Career and Education Awareness". San Diego State University 21 August 2008. 21 August 2008
<http://geoinfo.sdsu.edu/hightech/whylsGISValuable.htm>

GIS IN THE MODERN WORKPLACE

According to ESRI, GIS is used by 300,000 organizations worldwide, 45 of the top 50 petroleum companies, all 50 U.S. state health departments, and most forestry companies. GIS is also used by more than 24,000 state and local governments including Paris, France; Los Angeles, California, USA; Beijing, China; and Kuwait City, Kuwait².

In California alone, the number of positions that involve the use of GIS grew from 12,300 to 20,500 (66.7% growth), between 1998 and 2008³. This growth is expected to continue, creating a strong demand for those who have an understanding and knowledge of GIS.

These figures point to the fact that GIS is rapidly becoming a required skill in the modern workplace.

Occupations such as research analyst, drafter, cartographer, marketing analyst, and distribution manager already require a basic level of competency in GIS. Positions including advertising consultant, air traffic controller, railway manager, transportation planner, public safety dispatcher, and many more that previously did not require a basic understanding of GIS now require it, as employers are adding GIS duties to these occupations.

Some of the new GIS duties that modern employers have added to existing occupations include the following:

- Using computerized cartography tools
- Data entry into a spatial database
- Interpreting and mapping spatial data
- Exporting spatial-based map data
- "Geocoding" places regarding space and distance
- GIS database management

The need for skilled workers who have a basic understanding of GIS is present now more than any other time in history. Positions that have added duties in GIS are expected to grow as more and more businesses are looking to utilize and maintain accurate spatial data.

2. "About ESRI". *Esri.com* No Date. 20 June 2008 <http://www.esri.com/company/about/facts.html>

3. "Geographic Information Systems (GIS) Specialists". *California EDD Occupational Guide*. No Date. 4 Aug, 2008 <http://www.calmis.cahwnet.gov/file/occguide/geogspec.htm>

INDUSTRIES AND EMPLOYERS IN THE MODERN WORKPLACE THAT ALREADY USE GIS

The extensive capabilities of GIS allow more and more employers to embrace geographic software in places where it may not have been used before. Advertisers are using GIS to target markets. Farmers are using GIS to plan crop rotations. Tourist destinations, such as the San Diego Zoo are using GIS to track the flow of visitors on any given day. These and many more employers are finding new and innovative uses for GIS.

In a PowerPoint presentation titled "GIS: What is it? Who uses it?", Shannon White, a professor at North Carolina State University describes GIS as "flexible enough to map any kind of terrain, even the human body."⁴

Because GIS offers to employers a wide variety of uses across various disciplines, a growing number of diverse employers and industries find value in hiring individuals who possess a basic knowledge or expertise in GIS. These industries include:

Banking

Banking is a personal business where people are more than numbers, records in a database, or account codes. Armed with detailed customer information and new methods of linking clients to preferences and likely activities, banks can be much more successful in designing products and services that best fit their most profitable customers' needs⁵.

The banking industry uses GIS in the following areas:

- Advertising
- Asset Management
- Market Analysis/Research
- Operations Management
- Regulatory Compliance

4. White, Shannon. "GIS: What is it? Who uses it?" 2002. Online PowerPoint. North Carolina State University. 20 June, 2008. <http://research.csc.ncsu.edu/ontrack/SummerCamp/2002/Presentations/shannon.ppt>

5. "GIS for Banking and Financial Services". Esri.com No Date. 20 June, 2008 <http://www.esri.com/industries/banking/index.html>

Business

Private organizations today have a world of information they need to manage and synthesize to make effective decisions. While the volume and complexity of this data increases every day, companies need to unlock its value to enhance operational efficiency, deliver cost savings, and improve risk management⁶.

Private businesses use GIS in the following areas:

- Advertising
- Construction
- Facility Maintenance
- Farming
- Market Analysis/Research
- Shipping

Defense and Intelligence

GIS is widely used throughout the war fighter, business, and strategic intelligence domains⁷.

GIS is applied by Defense and Intelligence in the following areas:

- Base Operations/Facility Maintenance
- Chemical, Biological, Radiological, Nuclear, and High Explosive Incident Planning and Response
- Command and Control
- Defense Mapping
- Force Protection and Security
- Environmental Security and Resource management
- Health and Hygiene
- Intelligence, Surveillance, and Reconnaissance Systems
- Logistics
- Military Engineering
- Mine Clearance and Mapping
- Mission Planning
- Modeling, Simulation, and Training
- Peacekeeping Operations
- Visualization

6. "GIS Business Solutions". [Esri.com](http://www.esri.com/industries/business/index.html) No Date. 20 June, 2008
<http://www.esri.com/industries/business/index.html>

7. "GIS for Defense and Intelligence". [Esri.com](http://www.esri.com/industries/defense/index.html) No Date. 20 June, 2008
<http://www.esri.com/industries/defense/index.html>

Education

K-12 schools, community colleges, libraries, and museums can use GIS to study geographic features and the relationship between them. By better understanding how features within the landscape interact, information can be made accessible and easy to understand. This information can then be used by decision makers to optimize efficiency and improve economic returns⁸.

Education uses GIS in the following areas:

- Boundary Mapping
- Bus/Transportation Route Mapping
- Classroom Instruction
- Community Mapping
- Demographic Mapping
- Research

Government

GIS technology is used to establish and regulate policy and to strengthen the welfare of citizens. Additionally, Economic development agencies work to advance the quality of life and strengthen the economic base of their communities by retaining and growing existing businesses and attracting new investment⁹.

The Government uses GIS in the following areas:

- Census Data Mapping
- Economic Development
- Elections/Election Support
- Land Recording
- Street Planning
- Transportation Network Mapping
- Transportation Planning
- Urban/Regional Planning
- Waste Management Logistics

8. "GIS for Higher Education". *Esri.com* No Date. 20 June, 2008
<http://www.esri.com/industries/university/index.html>

9. "Washington County Maryland Home Page". *Washington County, Maryland* No Date. 23 June 2008
http://www.washco-md.net/planning/gis_general.shtm

Healthcare/Public Health

Most health and human service problems facing the world today exist in a geographic context and any analysis must consider that. Understanding issues ranging from medical epidemiology to healthcare access requires a comprehensive understanding of their geography¹⁰.

The healthcare and public health industries use GIS in the following areas:

- Illness/Outbreak Analysis
- Managed Care Administration
- Trauma Analysis/Disaster Relief

Insurance

Geography is a key tool in understanding customers, policies, claims, risk, and assets. GIS provides tools to leverage this geographic component to manage exposure to loss while successfully competing in an increasingly demanding marketplace¹¹.

The insurance industry uses GIS in the following areas:

- Advertising
- Market Analysis/Research
- Processing Claims
- Regulatory Compliance
- Risk Assessment

10. "GIS for Health and Human Services". *Esri.com* No Date. 23 June, 2008
<http://www.esri.com/industries/health/index.html>

11. "GIS for Insurance". *Esri.com* No Date. 20 June, 2008
<http://www.esri.com/industries/insurance/index.html>

Law Enforcement

Today's law enforcement agencies face a multitude of tasks and challenges. Over the past decades, the responsibilities of police agencies have expanded into many areas including school resource duties, drug prevention programs, and new policing methodologies such as problem-oriented policing or community-oriented policing. Since the terrorist attacks of September 11, 2001, officers are being asked to be "first discoverers" of threats as well as first responders when an incident occurs¹².

Law enforcement agencies use GIS in the following areas:

- 911 Mapping and Computer-aided Dispatch
- Community Corrections
- Crime and Investigative Analysis
- Emergency and Event Management
- Emergency Notification
- Emergency Preparedness
- Homeland Security
- Intelligence Analysis
- Intelligence-led and Community Policing
- Mobile (in-vehicle) Mapping
- Public Information
- Resource (vehicle and personnel) Tracking
- Traffic Analysis

Media

GIS is used by media bureaus for everything from analyzing circulation and attracting advertisers to creating the maps used in the material itself. GIS provides journalists with more effective tools to report the news and put it in context for readers. For media business executives, it manages the networks that facilitate subscriptions and distribution¹².

The media industry uses GIS in the following areas:

- Advertising
- Data/Media Mapping
- Illustration
- Journalism
- Routing/Logistics

12. "Law Enforcement – Public Safety". *Esri.com* No Date. 20 June 2008
http://www.esri.com/industries/public_safety/law_enforcement.html

13. "GIS for Media". *Esri.com* No Date. 20 June, 2008
<http://www.esri.com/industries/media/index.html>

Natural Resource Management

Natural resources—whether terrestrial, marine, or atmospheric—are finite, and the measurement and management of these resources are gaining importance as increased demands are put upon them¹⁴.

The natural resource management industry uses GIS in the following areas:

- Agriculture
- Archaeology
- Coastal Management
- Flood Management
- Forestry
- Mining
- Ocean Industry
- Oceanography
- Petroleum/Oil Drilling
- Water Resources/Groundwater Tracking

Public Safety

The safety and security of citizens, property, critical infrastructure, and natural resources is of paramount importance. Natural disasters, emergencies, crimes, and the threat of terrorist attacks require rapid response and comprehensive planning, from public safety agencies. Today more than ever, public safety officials are using GIS technology to better understand how to protect the geography of their communities. GIS helps analyze and display historical events, natural hazards, technological hazards, vulnerable populations, and critical infrastructure key to the community's sustainability¹⁵.

GIS is used in the following areas to assist with the administration of public safety:

- Computer Aided Dispatch
- Disaster Management
- Emergency Medical Systems Response
- Homeland Security
- Law Enforcement
- Structural Fire Protection
- Wildfire Management

14. "GIS Environmental Management". [Esri.com](http://www.esri.com/industries/environment/index.html) No Date. 20 June, 2008
<http://www.esri.com/industries/environment/index.html>

15. Public Safety – "Main". [Esri.com](http://www.esri.com/industries/public_safety/index.html) No Date. 20 June, 2008
http://www.esri.com/industries/public_safety/index.html

Real Estate

From map-based contact management to sophisticated investment analysis in large real estate investment trusts, real estate agencies rely heavily on electronic mapping. Many realtors have found great success in using the Internet to market properties. Companies such as **SSR Realty Advisors, Inc.** use GIS in commercial real estate, while **REALTOR.com** uses GIS to bring maps online¹⁶.

The real estate industry uses GIS in the following areas:

- Appraisals
- Commercial Real Estate
- Multiple Listing Services
- Processing Titles
- Residential Real Estate

Surveying

Surveyors and engineers understand the importance of geographic data. Surveyors use precise instruments, procedures, and computations to accurately locate and define geographic features while conducting field surveys that range from cadastral to engineering construction layout. Engineers design and build structures and infrastructures on geography measured by surveyors¹⁷.

Surveyors businesses use GIS in the following areas:

- Computation/Analysis
- Data Management
- Field Mapping
- Research

16. "GIS for Real Estate". *Esri.com* No Date. 20 June, 2008
http://www.esri.com/industries/real_estate/index.html

17. "Surveying Industry Solutions". *Esri.com* No Date. 20 June, 2008
<http://www.esri.com/industries/surveying/index.html>

Transportation

Transportation professionals across the globe use GIS as a tool in managing, planning, evaluating, and maintaining transportation systems¹⁸.

The Transportation industry uses GIS in the following areas:

- Airport Noise Reduction
- Asset Tracking
- Dispatching, Routing, and Scheduling
- Railway Management
- Roadway Management
- Territory Optimization
- Transportation Grid Mapping
- Water Transportation

Telecommunication

Telecommunication professionals are now integrating location-based data into analysis and management processes in network planning and operations, marketing and sales, customer care, data management, and many other planning and problem-solving tasks. This data becomes critical when interfacing with partners, clients, and customers¹⁹.

Telecommunication companies use GIS in the following areas:

- Marketing and Sales
- Network Planning
- Wireless Engineering

18. "GIS for Transportation". *Esri.com* No Date. 21 June, 2008
<http://www.esri.com/industries/transport/index.html>

19. "Telecommunications". *Esri.com* No Date. 21 June, 2008
<http://www.esri.com/industries/telcom/index.html>

Tourism

People go to destinations for various reasons, dependent on their preferences for sport, relaxation at the beach, mountain scenery, events, and/or meeting friends. The places that they choose to go often match their budget and desires. The data gathered from using GIS allows industry professionals to match trends and the preferences of individuals on a regional basis, thereby enhancing the experience of the tourists that come to the area²⁰.

The Tourism industry uses GIS in the following areas:

- Attendance Patterns
- Development and Research
- Facility Management
- Marketing
- Traffic Analysis

Utilities

Competitive pressure and regulatory constraints are placing increasing demands on utility companies and pipeline operators to operate in an efficient and responsible manner. Responding to these demands requires accessibility to information regarding geographically distributed assets and operations²¹.

Utility companies use GIS in the following areas:

- Groundwater Remediation/Visualization
- Publications and Media
- Risk Management
- Route Planning and Construction
- Supply and Market Analysis

20. Specht, Alison. "GIS Tools for Tourism Management". [Goasdoue.com](http://www.goasdoue.com) 17 April 2003. 21 June, 2008
<http://www.goasdoue.com/hotspots/>

21. "Pipeline Industry". [Esri.com](http://www.esri.com) No Date. 21 June, 2008
<http://www.esri.com/industries/pipeline/index.html>

Wildlife Conservation

Sustaining biodiversity and preventing fragmentation, extinction, and natural resource depletion are crucial to conservation of the environment. The spatial and thematic aspects of GIS technology enable users to overlay various data to delineate and predict the future of our resources, land, ocean, plant life, and wildlife. This geoprocessing enables decision makers to implement laws and programs that will protect and sustain the environment and its resources²².

The Wildlife Conservation industry uses GIS in the following areas:

- Landscape Mapping
- Mapping Environments (woodlands, wetlands, and watersheds)
- Mapping Marine Environments
- Tracking Global Climate Change

22. "GIS for Conservation". [Esri.com](http://www.esri.com) No Date. 21 June, 2008
<http://www.esri.com/industries/conservation/index.html>

EVALUATION

The number of businesses that need to maintain spatial data is projected to increase, thus increasing the demand for individuals with the knowledge and understanding of GIS. In order to meet this demand, Employers are looking to the high schools and colleges.

More graduates than ever are looking to gain employment in industries that require graduates to have a knowledge and understanding of GIS. The marketplace calls for new skills and knowledge²³. The college degree, once vital to a corporation, has lost value in this new environment without basic skills, such as the knowledge and understanding of GIS.

Essential skills that relate to the modern workplace are sorely needed from all job seekers. Essential skills relating to GIS can be obtained from taking GIS-specific classes in college or from additional training beyond college. The benefit of the knowledge and understanding of GIS is mutual to job seekers and employers; those seeking a job will become more productive and better prepared for employment in the modern workforce and employers will be able to gain a workforce that is competent in maintaining spatial data.

23. Fraunces, David. "Preparing Students for the Workforce is Everyone's Responsibility". Auburn University. No Date. 11 August, 2008
<http://www.auburn.edu/administration/horizon/fraunces.html>