GEOGRAPHIC INFORMATION SYSTEM AS A COMPLEMENT TO THE INFORMATION SCIENCES AND TECHNOLOGY PROGRAM AT PENN STATE UNIVERSITY

Francis W. Derby, Ph.D., Willie Oforu, Ph.D.

**The Pennsylvania State University
P. O. Box PSU
Lehman, PA 18627**

Abstract

Current technological advances are emphasizing the need for cross-disciplinary training and expertise. The technology for managing information is transforming the manner in which information is captured, processed, stored, and disseminated. A catalyst to the development is the need for timely information by administrators, technicians, businesses, and the public in general. One application where cross-disciplinary expertise becomes evident is in the development and utilization of Geographic Information System (GIS).

As a resource management and decision support tool, a GIS enables users to analyze spatially referenced data. The system depends, for its effectiveness, on the variety and volume of data that must be gathered. The effectiveness of the system is dictated by the use of computers and database management systems. These requirements imply that GIS analysts have to be adequately versed in Information Sciences and Technology (IST).

Components of an IST program that meet the requirements in GIS are information management and data communications. Proper acquisition, analysis, and handling of information are critical in making the information useful to decision makers, as well as, other users of the information. Computer technology and database management support such applications. Training of personnel in GIS should cover topics in both geography with reference to the population, and information systems with a healthy concentration in computer technology. Penn State University has initiated an IST program and it is intended to make GIS one of the course offerings.

Introduction

In recent years, Geographic Information Systems (GIS) have become standard tools for Federal, local and private agencies to plan developments, determine the most appropriate location for

siting facilities, manage resources, and for supporting management decisions. As a system whose functionality depends on spatially referenced data, the GIS technology has mainly been applied by geographers, surveyors, environmental scientists, conservationists, planners and other professionals who deal with spatial data on a regular basis.

In several universities, GIS is taught in many departments such as civil engineering, geography, agriculture, environmental sciences, business, and planning. GIS instruction in these departments are tailored to satisfy applications within the discipline. A common link to all these applications, which is the information management component, is offered in the computer science department. Unfortunately, the computer scientist is not exposed to this widely expanding GIS technology. GIS technology has matured to a level where certain implementation across enterprises require more expertise, if not equal, in information management and data communication than spatial accuracy. When moving large volumes of data across the Internet for example, knowledge in data communications is as important as spatial accuracy.

Information management and data communication skills are becoming just as critical in successful GIS implementations. Employers are requiring more knowledge in these areas too. GIS, which is itself a cross-discipline technology, is demanding a deeper understanding of computer technology, database management, data analysis and data communications. Through a cross-disciplinary effort, certain components of a GIS program will be offered as complement to the Information Sciences and Technology program at Penn State University. This will create a better understanding and more collaboration between the Information Management Systems (IMS) department and the GIS personnel within the industry. This paper looks at this unique effort to link the two information systems and to offer students an opportunity to better appreciate information technology requirements in a GIS setting.

What is GIS

Geographic Information Systems are tools for organizing and displaying spatial data as well as analyzing impacts of alternative decisions. A GIS is a decision support system whose strength lies in its capability to model and analyze spatial relationships over time. It can provide answers to queries pertaining to location, condition, and patterns in any location. It can also be used to identify trends and to model change within a defined location. A good GIS can lead to better information and therefore better decisions.

Since any GIS relies on the availability of spatial data, data acquisition and preparation are important activities for ensuring its success. Although other activities such as data storage and retrieval, data analysis, and disseminating of information are essential, expertise in these areas have been considered secondary to the knowledge in say, surveying, geography, forestry, and environmental science. In the past, advertisements for GIS positions have placed emphasis on sound knowledge of the application of the technology, rather than the management of the information. The trend is rapidly changing. GIS analysts are now expected to possess, at the minimum, a working knowledge in computer technology, database management, data communication, data analysis, and network administration

Why is GIS so important

Aided by the increasing capabilities of the computer and the substantial reduction in price, computers have been dominant in dictating the application of GIS technology. The analytical capabilities of the GIS has been made possible, largely by the computer and the appropriate software for performing complex analysis on spatial data. In today's business, information is critical. Timely information is even more critical to the success of any enterprise. In a decision making process, lack of information impairs choice and forces decisions to be made in an atmosphere of uncertainty. The technology for providing such information is rapidly increasing in sophistication. Thus, decision makers are being compelled to seek resources that will help them to make better decisions. A GIS has become the appropriate technology to assist policy and decision makers to make informed decisions and improve the odds among available choices.

Within the last decade, applications of GIS technology have increased considerably, as a wider group of agencies and managers adopt the technology. International agencies such as the United Nations and the World Bank are utilizing the GIS to manage economic development, natural resources, and the ecosystems in various parts of the globe. In the United States, several agencies of the Federal government are currently using the technology to manage resources, support and monitor the impact of policies, and enforce environmental regulations. At the State and local government levels, GIS is being used for disaster evacuation planning, coastal resource management, emergency response, to model and sustain growth, plan and manage resources, plan economic development, and support land administration and revenue collection. Private sector applications include real estate sales, real estate management, retail industry to site franchises, banking, tourism, the cable and wireless industry to locate and solicit customers, and many more. New applications are evolving constantly. Application of the GIS is limited, only by lack of appropriate data or by poor organization of the data.

Current state of the technology

Over the last ten years Federal, State and local governments have labored through data capture and processing activities to gather the necessary data that will be required in a functional GIS. Grants have been awarded to State and local agencies to be used to develop internal systems. In many areas, initial GIS applications were project oriented such as resource mapping, inventory management and location of facilities. Project-based GIS implementations were limited in scope and required basic understanding of database management and analytical expertise and perhaps little computer hardware skills. Data communication was not a required skill. Results of such applications were hard copy products and reports which were archived and sometimes forgotten. The result was a constant duplication of data capture efforts due to divergent objectives and lack of standardization among agencies with regard to data type, accuracy, and structure.

A much broader application is an Enterprise-wide GIS implementation. Having gone through data capture phase and established some standards and eliminated duplications, several agencies have realized other applications which were hitherto impossible. In Enterprise-wide GIS

implementation, data are captured, organized, and stored in a manner that the GIS can be used to support several of the activities within the enterprise or agency. Such implementations require different treatment with regards to data types, standards, accuracy, structure, organization, and even management procedures. It also requires closer collaboration among units within the organization that plan on using the functional GIS. For International, Federal and State organizations that are geographically dispersed, additional requirements are made on skills such as network administration, data communications, and database management. These are skills which were not considered important in the early stages of the technology.

Future direction and applications of the technology

To date, the technology has been most beneficial to businesses and agencies at the International, Federal, State, and County levels. However, the scope of applications are widening. Real-time GIS applications are emerging trends. The use of GIS as navigational systems in airplanes and direction finders in cars are only two of the common applications. Another emerging application is GIS in a Personal Organizer, which can be used to locate for example, the nearest Automatic Teller Machine that is owned by a particular bank or does not charge a user-fee. Another interesting application is to locate the nearest restaurant that caters a certain kind of cuisine. Other applications are emerging which will enhance the societal application of Geographic Information Systems. As society develops to the point where information of societal nature become necessary, different demands are going to be placed on the GIS analyst.

GIS over the Internet is bringing a whole new dimension to the caliber of GIS analysts that will be required in the future. Most people have used applications such as Mapquest on the Internet to obtain maps and driving directions. Mapquest is a different example of GIS application which has no geographic boundaries. Until now geographic data that have been compiled for GIS applications are specific to geographic regions. With the Internet, geographic boundaries are only imaginary. By linking data servers that store data about individual geographic locations, the entire world could be made into a single GIS boundary. This means that data could be obtained from servers all over the world to process a single query. International and Federal agencies, as well as, governments of foreign countries and educational institutions would benefit mostly from such applications. Again, this calls for a more sophisticated data organization, standardization with regards to resolution, accuracy, currency and structure. This application also calls for a different kind of GIS analyst. For example, the server and the communication network should be capable of transferring large volumes of data across the network over long distances within a short time and the GIS analyst should also be an expert in the technology which makes this possible.

IST and GIS Integration at Penn State University

From the foregoing, it is clear that the GIS analysts should not only possess the expertise to analyze geographic data, but the ability to manage information and to disseminate it

appropriately and in a timely manner. This calls for a closer look at the kinds of training that are currently offered to students of GIS, so as to prepare them for responsibilities as analysts of the near future. The question to answer is “what happens after all the geographic data have been captured in a resolution that is appropriate for most major applications except perhaps engineering?” Clearly, future GIS applications will require a lot more than just the ability to perform geographic analysis. Information Sciences and Technology courses should play a major role in the activities of the GIS analyst. The IST program at The Pennsylvania State University is designed to address the computer technology and information management requirements of applications such as Geographic Information Systems.

Computers in current use are capable of processing and analyzing vast amounts of information in relatively short periods of time. In dealing with information technology therefore, one has to have a working knowledge in both the software component which deals with data, and the hardware component which deals with computers and their associated peripherals. These two requirements form the two pillars on which the IST program is built on. The program focuses on information. As such, its structure is not as would be expected for a program in computer science or computer engineering program. Even so, it is important to build into the program a substantial foundation in both computer science and computer engineering.

As the name suggests, the Information Sciences and Technology program is designed to train students to deal with information from a systematized perspective. The courses are structured such that the students will appreciate the practical application of the knowledge gained. Class exercises and case studies which form part of the students’ course work are carefully designed and build on top of each other in a progressive manner. The graduate from the IST program will be expected to effectively assess a problem, decide on the appropriate data to collect, analyze the data efficiently, and produce results that will be appropriate for solving the problem.

In associating the IST program and the GIS component of the Surveying program, a decision had to be made whether to have IST students choose GIS courses as electives or to have Surveying students choose electives from IST courses. It was important to consider the addition of extra courses without increasing the course load and still make it possible for students to complete the chosen program within four years for a baccalaureate program. Some of the factors considered were the types of topics that would be needed to provide the students with a comprehensive understanding of the subject. The two broad areas involved were geographic and surveying principles, and information technology. To somewhat lesser extent, calculus and data communications were also involved. The strength each of these subject areas lend to the GIS option originate from the importance of each of these to industry as programs in their own right. In the end its was considered prudent for IST students to choose to major in GIS applications. Whiles this choice does not offer opportunities for the IST graduate to become a licensed surveyor, he/she has a better appreciation of spatially related information and GIS concepts.

Benefits of IST-GIS integration

There are many advantages to using IST as a basis in developing a GIS program. Firstly, the concept demonstrates the importance of information science in this technological era. The systematized approach help students to appreciate the need of viewing information from a scientific standpoint. Secondly, computer applications is treated such that the students view computers as working tools. From this standpoint, the power, speed and versatility of computing can be gainfully employed in dealing with the data capture, processing and disseminating information. Thirdly, students perceive a clear demonstration of the importance and strengths that can be gained from the cross-discipline approach to education. It broadens their choices in the number of companies to work for, as a result of their multi-disciplinary training. IST will give the students a good insight to the hardware required in dealing with data transmission and reception. This will be invaluable whether the graduate from this program ends up working for a small company. in the former situation, the graduate may be the only one with the necessary understanding to make valued judgement on the type of equipment in which to invest, from reviewing both the immediate and long term plans of the company.

Conclusions

Information technology will grow as more and more people need information in their activities. Increasing population, as is happening, has led to more land development as both residential and business areas. This fact forecasts growth in the GIS field. Coupling these facts indicates a growth that will be served well by the development of the GIS option. Current trends in industry also support the cross-discipline approach to learning. A fact that must be stressed when examining current trends is the desire for life-long learning. An evidence to this fact is the rate at which new technological developments are being presented to the user. These developments mostly stem from the growth of the computer industry. This has a direct impact on information technology, and hence on all professions that employ information technology. A requirement for the GIS option in the IST program will therefore be to update the course material as time goes on to take advantage of the new developments as they become available.

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FRANCIS W. DERBY

Francis W. Derby, is an Assistant Professor of Surveying and Geographic Information Systems at The Pennsylvania State University, where he teaches Photogrammetry, Remote sensing, and GIS. Dr. Derby's research interests are spatial data accuracies and development of enterprise GIS.

WILLIE K. OFOSU

Willie K. Ofosu is an Assistant Professor and Chair of Telecommunications at Penn State, Wilkes-Barre. His research interests are RF components and antennas. Dr. Ofosu received his Ph.D. from the Electronics Department at University of Essex, England in 1994.