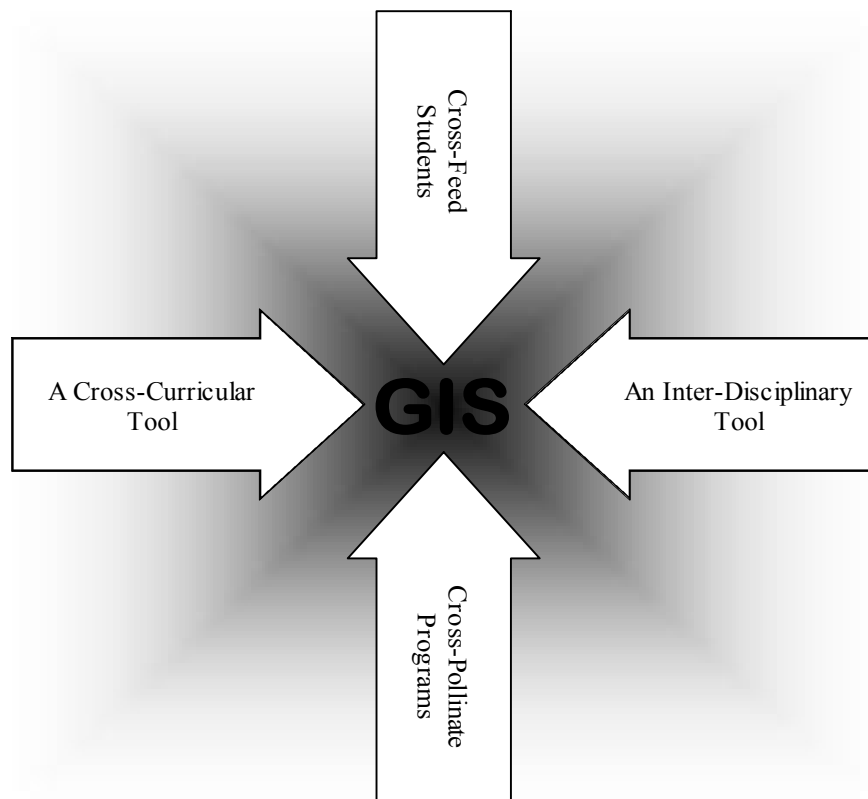# Curriculum Analysis for San Diego Mesa College (NSF-ATE):

Summary of Applicability of Geographic Information Systems (GIS) Curricula in Various Certificate and Degree Programs at San Diego Mesa College

Cross-Feed Students

A Cross-Curricular Tool

GIS

An Inter-Disciplinary Tool

Cross-Pollinate Programs

Curriculum Analysis for San Diego Mesa College (NSF-ATE):

Summary of Applicability of Geographic Information Systems (GIS) Curricula in Various Certificate and Degree Programs at San Diego Mesa College

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Abstract

ABSTRACT

Executive Summary:

Geographic Information Systems (GIS)

GIS generally refer to software tools to store, map, visualize, and analyze any kind of data with a spatial component in order to aid in decision making.(Peng and Tsou, 2003) It is widely recognized that most observable/measurable phenomena, and its associated data, have some kind of spatial or location component.(Pace et al., April 2000) Examples include counts, temperatures, prices, speeds, trends, rates, sales, slopes, directions, colors, brightness, etc. In fact, it is difficult to identify phenomena that *completely* lack a spatial component.

The Growth of GIS Utilization in Education and Industry

The National Research Council (NRC) and other government entities have recognized GIS, and its requisite spatial skill set as one of the fastest growing segments of technology.(National Research Council, 2005) Additionally, the NRC and other leading advisory bodies anticipate a severe labor shortfall of skilled workers with working knowledge of GIS and general spatial principles.(Sietzen, June 2004) In anticipation of this, and to maintain a leading role for American workers in the 21st Century global workplace, the NRC has recently issued strong recommendations for mandated spatial knowledge and skills education in K-12 schools.(National Research Council, 2005) No doubt, this will have a profound impact on our educational system at the local, regional, and national levels. Secondary school graduates, whose appetite will be whetted by their mandated training/instruction in, and increasing exposure to, GIS and related technologies; in addition to growing industry demands, present a great challenge and opportunity for educators and administrators in post-secondary educational programs. This document, along with the efforts of the NSF-ATE researchers(NSF-ATE DUE #0401990, 2005), are directed towards addressing these critical needs.

A Multi-Disciplinary Tool

GIS is a multi-disciplinary tool with enormous potential and a broad reach into a diversity of fields. It is a tool that can be used to support education, projects, studies, analyses, and presentations in almost every field and discipline from Accounting to Travel and Tourism.

New cross-disciplinary applications of GIS technology appear everyday. Some applications include using GIS to select an optimal site to open a new business based on supply line, customer, and financial overhead considerations; or using

ABSTRACT

GIS to chart the spread of an infectious disease over time and allocate resources in an optimal way to manage the outbreak.

Contrary to the average person's understanding of the technology, it is not limited to mainstream consumer items such as car navigation systems, GPS receivers, or Web map tools such as Expedia and MapQuest.

West Virginia University's GIS Technical Centre did a one-year study on GIS utilization based on the requests they received for GIS assistance and expertise from various public and private agencies and organizations.(West Virginia University, 2004) A brief review of their study results **clearly** confirms that GIS is a true multi-disciplinary tool:

> *Service Request Report*
> > *255 e-mailed or telephone requests for data, conversion of data, technical support, or map projects for the time period 12/1/2003 to 12/1/2004.*
>
> *Report by Service Type*
> > *Data Request............55%*
> > *Technical Support......35%*
> > *Map Projects..............9%*
> > *Data Conversion.........1%*
>
> *Top Data Request for Support*
> > *Digital Orthophotos* [aerial or satellite background imagery]
>
> *Report by Organization Type*
> > *Commercial..............33%*
> > *Education.................28%*
> > *State........................18%*
> > *Non-Profit.................8%*
> > *County.....................4%*
> > *Regional...................4%*
> > *Federal.....................3%*
> > *City..........................2%*
>
> *Report by Application*
> > *a wide range of applications use geographic information:*
> >
> > > • *Architecture*
> > > • *Art*
> > > • *Biology*
> > > • *Cadastral* [land parcel mapping]
> > > • *Criminal Justice*
> > > • *Demographics*

- *Economic Development*
- *Education*
- *Energy*
- *Engineering / Land Survey*
- *Environmental Studies*
- *Facilities and Planning*
- *Flood Mapping / Planning*
- *Forestry*
- *Geology*
- *Health*
- *History / Cultural*
- *Hydrology*
- *Land Use / Land Cover*
- *Local Government*
- *Natural Resources*
- *Soils*
- *Tourism / Recreation*
- *Transportation*
- *Utilities*

(West Virginia University, 2004)

Learning with GIS

GIS is a tool not only for students, but for educators and administrators as well. The process of learning about GIS is itself beneficial to students. For students from elementary through graduate school, GIS engages many learning styles and provides a framework for all types of academic subjects. GIS continues to be a powerful research and presentation tool for both students and faculty at the college and university level. GIS has also become a job skill that is in demand. Professionals working in many fields recognize that GIS training is a valuable career asset. They are pursuing GIS education provided by degree and certificate programs and through courses taught in the classroom or over the Web. Finally, school administrators on all levels can use GIS as a management tool.(ArcUser, 2000)

Empowering Students with a High-Demand Set of Tools and Knowledge

To mirror and support the rapid cross-disciplinary expansion of GIS utilization in industry and to enrich students with an expanded skill set valuable in several diverse and unrelated fields, this document summarizes applicability of GIS curricula in all programs at San Diego Mesa College.

ABSTRACT

Not only does GIS provide an avenue to beneficially cross-feed students and cross-pollinate programs, it also enriches students with a wider skill set that will prove to be invaluable for their current and future growth, development, and employment.

San Diego Mesa College is in a very special position to pursue these goals. This is because it is the principal recipient of a major National Science Foundation grant with San Diego State University and the San Diego City Schools to support and expand GIS and spatial skills education.(NSF-ATE DUE #0401990, 2005) Additionally, San Diego is widely considered to be a GIS and related spatial technology hub. This is because of the extensive use and innovation of GIS and other spatial technologies by regional businesses, governments, and agencies. It is also the permanent host of the annual ESRI Users Conference. This conference is attended annually by 10,000+ users of the world's premier software tool supporting GIS. Incidentally, ESRI reports that their business and conference attendance has consistently grown about 15% a year since their first users conference in 1981.(ESRI[2], 2005)

It is hoped that San Diego Mesa College can meaningfully assist the local region in meeting its high-tech educational and labor needs by being able to produce competent workers with working knowledge of GIS applications and related technologies.

Audience:

NSF-ATE Grant Principal Investigator, San Diego Mesa College Deans, San Diego Mesa College Department Chairs, San Diego Mesa College Administration, Faculty and Staff

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August 17, 2005

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Summary of Findings

General Findings:

Interpretation of Findings

This section includes tables which summarize the applicability of GIS curricula in San Diego Mesa College academic programs. Supporting arguments for these results are made in the individual sections following the tables.

A rating of one (1) represents "slight" applicability. This implies that there are organizations and institutions who have adopted GIS or similar spatial technology but they are not mainstream or numerous. This does not necessarily mean that there is a weak argument for adoption of GIS technology in this area/field. It simply implies that GIS adoption is not yet wide spread. When requirements at these organizations or institutions call for expertise in GIS or other spatial technologies, it is often out-sourced to consultants, at great expense, when the knowledge and skill set isn't available in-house.

A rating of five (5) represents the highest level of applicability. This implies that there are well-established precedents and acceptance of GIS utilization in industry, organizations, and institutions in this area/field. GIS utilization and representation in these fields/areas is considerable. At these organizations and institutions, there may be staff members (or whole sections of staff members) who are specifically retained for their GIS and spatial technology expertise.

"Intermediate" ratings of two (2) through four (4) subjectively represent different degrees of applicability of GIS curricula in the programs.

Any level of applicability implies that GIS curricula would potentially benefit the noted program and its students/participants. GIS curricula could contribute to an enhanced & value-added educational experience consisting of cutting edge knowledge and skills training, reflecting current trends and best practices in industry and elsewhere.

To address these cross-curricular recommendations, immediate actions can include approval of SDMC GIS program courses as electives in the noted programs.

With time, stronger ties between the SDMC GIS program and the noted programs may prove mutually beneficial. Many existing inter-disciplinary collaborations at other organizations and institutions are documented in the individual sections following the tables. Inter-disciplinary collaborations with GIS and other spatial technologies, at other educational institutions, have brought enrollment growth, notoriety, and additional funding to each participating department/program.(Western Kentucky University, 2001) (Unity College, 2000) (Hassen, 2003)

SUMMARY OF FINDINGS

Additionally, there is often a strong argument for the SDMC GIS program to accept courses *from* other programs as electives for students already in the GIS program. Details of these recommendations are covered in the individual department listings.

Fields/areas that have very little or no GIS applicability are not listed in the individual sections following the tables.

Disclaimer:

This is by no means an exhaustive analysis due to budgetary and time constraints. These limitations did not allow for formal empirical/statistical analyses of precedent, surveys, and instances of GIS curricula applicability in all of the fields/areas discussed.

The apparent frequency and degree of GIS applicability to various programs at different institutions and organizations was taken into consideration in this analysis. The author's domain knowledge was also utilized to form many of the opinions and conclusions in this document. Because of this, it must be emphasized that there is a strong degree of subjectivity in this analysis and it is, by no means, a scientific analysis.

In order to reinforce the arguments made in this document, a strong effort was made in citing precedents and instances of GIS curricula applicability in the various fields/areas. These sources are cited in the References section of this document. The References page is also available in Web page/hypertext format at http://geoinfo.sdsu.edu/hightech/Sources to facilitate further investigation and give the reader easy access to online Web URLs.

It is hoped that this document will be used as a guide. The audience is encouraged to investigate further and verify the validity of the document's conclusions and recommendations.

GIS Curricula Applicability (1-slight, 5-strong applicability)	*SDMC Program*	Stated Program's Curricula May Benefit GIS Program
2	Accounting	
	American Sign Language/Interpreting	
3	Animal Health Technology	
5	Anthropology	***see Other Notes
5	Architecture	***see Other Notes
1	Art-Fine Art	
5	Biology	***see Other Notes
2	Black Studies	
4	Building Construction Technology	
4	Business Administration	
3	Business Management	
2	Chicano Studies	
	Child Development	
5	Computer Business Technology	***see Other Notes
5	Computer and Information Sciences	***see Other Notes
	Consumer and Nutrition Studies	
	Dental Assisting (RDA/CDA)	
	Dramatic Arts	
	English	
	Fashion	
	Food Service Occupations	
*	Geographic Information Systems	
1	Health Information Technology	
	Hotel-Motel Management	
4	Interior Design	
2	Languages	
3	Liberal Arts	
5	Marketing	***see Other Notes
2	Mathematics	
	Medical Assisting	
3	Multimedia	***see Other Notes
	Music	
	Physical Education	
4	Physical Sciences	***see Other Notes
	Physical Therapist Assistant	
2	Psychology	
	Radiologic Technology	
4	Real Estate	***see Other Notes
1	Selected Studies	
5	Social Sciences	***see Other Notes
3	Sociology	
	Speech Communications	
	Transfer Studies	
2	Travel and Tourism	

Table 1: GIS Curricula Applicability to SDMC Programs (by SDMC Program Name)

SUMMARY OF FINDINGS

GIS Curricula Applicability (1-slight, 5-strong applicability)	SDMC Program	Stated Program's Curricula May Benefit GIS Program
*	Geographic Information Systems	
5	Anthropology	***see Other Notes
5	Architecture	***see Other Notes
5	Biology	***see Other Notes
5	Computer Business Technology	***see Other Notes
5	Computer and Information Sciences	***see Other Notes
5	Marketing	***see Other Notes
5	Social Sciences	***see Other Notes
4	Building Construction Technology	
4	Business Administration	
4	Interior Design	
4	Physical Sciences	***see Other Notes
4	Real Estate	***see Other Notes
3	Animal Health Technology	
3	Business Management	
3	Liberal Arts	
3	Multimedia	***see Other Notes
3	Sociology	
2	Accounting	
2	Black Studies	
2	Chicano Studies	
2	Languages	
2	Mathematics	
2	Psychology	
2	Travel and Tourism	
1	Art-Fine Art	
1	Health Information Technology	
1	Selected Studies	
	American Sign Language/Interpreting	
	Child Development	
	Consumer and Nutrition Studies	
	Dental Assisting (RDA/CDA)	
	Dramatic Arts	
	English	
	Fashion	
	Food Service Occupations	
	Hotel-Motel Management	
	Medical Assisting	
	Music	
	Physical Education	
	Physical Therapist Assistant	
	Radiologic Technology	
	Speech Communications	
	Transfer Studies	

Table 2: GIS Curricula Applicability to SDMC Programs (by GIS Curricula Applicability)

Description of Field Headings

DESCRIPTION OF FIELD HEADINGS

Description of the Summary Field Headings:

SDMC DEPARTMENT

The name of the department at San Diego Mesa College that can benefit from including GIS curricula in their program

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

A subjective scale ranging from 1 to 5 representing the degree of applicability of GIS curricula. (see Interpretation of Findings)

SDMC DEPARTMENT DESCRIPTION

The description or portions of the description of the department's program given in the 2005 – 2006 San Diego Mesa College Catalog

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

Summarized recommendations and justification for inclusion of GIS curricula in the department's program

CITED UTILIZATION IN ORGANZATION(S)

Cited examples of GIS utilization in public and private organizations. (*not* an exhaustive listing)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

Cited examples of programs at other schools that already include GIS curricula in their program(s). (*not* an exhaustive listing)

OTHER NOTES

Other relevant information

Accounting

SDMC DEPARTMENT

Accounting

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

2

SDMC DEPARTMENT DESCRIPTION

Qualifies the graduate as a bookkeeper, account clerk, accounting technician, audit or tax aide, or accountant trainee. Subjects of immediate practical value enable the student to work part-time in the field while completing the curriculum. The certificate program is for students desiring early employment. Students planning to transfer to a four-year college or university as an accounting major should major in Business Administration.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The primary benefit which a student/participant in accounting will realize by including GIS and general spatial knowledge in their "skills toolbox" is general competency with powerful tools for organization, presentation, and visualization of financial data related to location and/or time.

The student/participant will be able to generate powerful reports or construct persuasive arguments in order to influence, recommend, or direct policy within their organization. In other words, GIS skills and knowledge can be thought of as premium value-added skill in their portfolio which can ultimately put the student/participant in a better position to benefit their organization and their position within it.

Depending on the student's/participant's position within their organization, they may be able to realize the benefits of their advanced skill set immediately (by being able to market the skills and knowledge during the hiring phase of their employment); or in managerial/supervisory roles within their organization, where the student/participant is in a position to influence and provide feedback in organizational policy and direction. In reality, entry-level accounting professionals may not actually use their GIS

skills and knowledge until they progress into more of a managerial/directing role within their organization. Nonetheless, it remains an exceptionally marketable skill set and knowledge domain.

CITED UTILIZATION IN ORGANZATION(S)

Assessors Office Public Information Dissemination

GIS is extensively used as a tool to make assessor's office data, property tax information, and auditing services available to county residents in many areas across the country.

Union County Ohio provides summaries of their use of GIS tools to support dissemination of public information to property owners.(Union County Ohio, 2005)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Courses for Managerial Accounting

The University of Missouri at St. Louis offers a Managerial Accounting program that allows students to select an introductory GIS class in order to receive training on the use of GIS software. This also provides a foundation in using GIS for spatial analyses. In this class, a range of examples is used to emphasize the use of GIS as a tool to support analysis and decision-making.(University of Missouri, 2005)

OTHER NOTES

*

Animal Health Technology

SDMC DEPARTMENT

Animal Health Technology

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

3

SDMC DEPARTMENT DESCRIPTION

Prepares students for employment as an assistant to
graduate veterinarians in private veterinary facilities,
biomedical research institutions, regulatory agencies,
and zoological parks.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The primary benefit a student/participant in the Animal Health
Technology program will realize by including GIS curricula in their
coursework is general competency with powerful tools to support analysis,
presentation, and visualization of data primarily related to research
applications within the animal health field.

Powerful arguments and presentations of data can be made with GIS tools
to support and broadcast research data on animal movement, ranges,
productivity, health/diseases, conservation, counts, etc. This is because
the data can be presented and analyzed based on relative or absolute
location, and time.

With a GIS tool, the student/participant will be able to generate powerful
reports or construct persuasive arguments in order to influence,
recommend, or direct policy based on observed phenomena or
documented scientific evidence. Combined with associated reports,
presentations, and/or publications, the student/participant will be able to
provide much stronger documentary evidence supporting their
positions/arguments. In this sense, GIS skills and knowledge, to a
student/participant in the animal health field, can be thought of as an
enhanced research and presentation tool. This application of GIS will
support academic and field researchers, and organizational managers and
directors.

CITED UTILIZATION IN ORGANZATION(S)

An Integrated Hazards and Animal Health GIS

The North Carolina Department of Agriculture and Consumer Services has developed a Multi-Hazard Threat Database (MHTD) that was built on the North Carolina Animal Health Geographic Information System (NCAHGIS). The MHTD is a decision support tool that reduces threats and vulnerabilities to the citizens of the state of North Carolina; it supports all state emergencies; it is protected from public access and configured to map and assess biological threat information. The system is integrated with the North Carolina Department of Public Health, and other partners such as the Department of Defense, Department of Homeland Security, FBI, State Bureau of Investigations (SBI), the State Highway Patrol, and the North Carolina Emergency Management. The Department's Emergency Programs is partnering with multiple agencies at the federal, state, and local level to develop a one-medicine approach to surveillance, detection, diagnosis, and response using GIS.(North Carolina Department of Agriculture and Consumer Services, 2003)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Courses for Animal Health Research & Studies

The Royal Veterinary College at the University of London teaches three short courses in spatial epidemiology.

The first course is called "Investigation of Spatial Patterns of Animal Disease" and it consists of four units: Introduction to Geographic Data, Using a Geographic Information System, Exploring Spatial Data, and Explaining of Spatial Data.

The second course is called "Geographic Information Systems in the Spatial Analysis of Animal Diseases" and it consists of two units: Introduction to Geographic Data and Using a Geographic Information System.

The third course is called "Exploring and Modeling of Spatial Data in Veterinary Epidemiology" and it consists of two units: Exploring Spatial Data and Explaining of Spatial Data.(University of London, 2005)

OTHER NOTES

*

Anthropology

SDMC DEPARTMENT

Anthropology

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

5

SDMC DEPARTMENT DESCRIPTION

Students planning a major in anthropology should prepare themselves with undergraduate courses which complement that major. An undergraduate major in anthropology is not intended to be a training program, since professional anthropologists draw their experiences from a variety of academic backgrounds and personal experiences. It is recommended that a student who plans an anthropology major consult one of the anthropologists on the faculty for advice on courses that will be most valuable. For the non-major, anthropology will provide a unique cross-cultural understanding of other peoples.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The primary benefit a student/participant in Anthropology will realize by including GIS curricula in their program is general competency with powerful tools to support analysis, presentation, and visualization of data primarily related to research applications within the anthropology field.

Obviously, being able to abstract, represent, visualize, and analyze data based on location represents a very powerful tool for the field. Strong arguments and effective presentations using anthropological data can be made with GIS tools.

Data presentation and analysis are significantly enhanced by using GIS tools since they exploit the spatial and temporal dimensions of the data/observations. Combined with associated reports, presentations, and/or publications, the student/participant will be able to provide much stronger documentary evidence supporting their positions/arguments. In this sense, GIS skills and knowledge, to a student/participant in

anthropology, can be thought of as an enhanced research and presentation tool. This application of GIS will support academics, field-based researchers, and advisors in policy-making organizations.

Many of the arguments for GIS utilization as a research tool for students/participants in the Anthropology program are the same for the Social Sciences program.

(see Social Sciences)

Because anthropological data have a definite space and time component, there is a compelling argument for GIS use. GIS is increasingly being used in Anthropology programs and research worldwide.

CITED UTILIZATION IN ORGANZATION(S)

GIS in Anthropology and Archaeology

Anthropology and archaeology are disciplines that collect and use geospatial data. In a paper, it is argued that archaeology, in particular, is presently quite advanced in its use of GIS-related technologies (satellite data, GPS units, GIS mapping and spatial analysis). Cited examples of applications in anthropology and archaeology are provided in an annotated bibliography and through suggested Web links. The paper also asserts that anthropology has been slower to adopt GIS but applications are beginning to appear.(Matthews, October 2002)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Courses in an Anthropology Program

Centre Junior College Division of Social Studies in Danville, Kentucky offers a GIS course in their Anthropology program called "GIS and the Environment." The course is described as an introduction to the basic concepts and applications of Geographic Information Systems (GIS) as used in environmental studies. Students in the course receive hands-on training in the use of ArcView, the industry-standard GIS software; and the use of Global Positioning System (GPS) devices. Students also learn how to integrate data into GIS from sources such as maps, aerial photographs, and Landsat satellite images. Presumably, the skills taught within the department will assist the student with research methods, ethnographic investigations, and other advances within the ecological anthropology field.(Centre College, 2005)

GIS Used in an Archaeological Survey

As an excellent example of cross-disciplinary utilization of GIS in support of research, Texas State University-San Marcos' Anthropology department is exploiting GIS tools to augment archaeological field work with data from the Zeekoe Valley Archaeology Project (ZVAP) survey---the largest survey in Africa. They are taking ZVAP survey data and encoding it into a GIS along with site locations and topographic maps of the region. With the field data available in a GIS, the project will be able to conduct a detailed analysis of Stone Age and historic settlement patterns in a three-dimensional setting. Additionally, the data will be preserved and can be shared electronically for further analysis and posterity.(Texas State University, 2005)

Anthropology Emphasis in a GIS Program

Due to the utility of GIS to support Anthropology, Foothill College's GIS program includes Anthropology as a "focus area" in which GIS technology can be directly applied in a student's/participant's program. Besides further emphasizing the cross-disciplinary nature of GIS, the school is advantageously cross-feeding students in a broader more enriching program of study.(Foothill College, 2005)

Applied GIS Course in Anthropology and Archaeology

The University of Wyoming offers an introductory course in GIS covering how GIS is used in anthropology and archaeology.(University of Wyoming, 2005)

OTHER NOTES

Because of precedents at other institutions, classes in the Anthropology program are excellent candidates for inclusion as electives *in* the GIS program. It is a great way to provide students in the GIS program broad exposure to and an understanding of a field/area with rich spatially-associated data.

Architecture

SDMC DEPARTMENT

Architecture

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

5

SDMC DEPARTMENT DESCRIPTION

Architecture Option
Designed for those who desire employment in
architects' or engineers' offices or who plan to enter a
college of architecture or engineering. Emphasis is
placed on the office practices, procedures, principles
and ethics of these professions. Students planning to
transfer to a school of architecture should consult with
architectural counselors to select acceptable transfer
courses.

Landscape Architecture Option
The landscape architecture program is designed to train
individuals to have employable technical skills related
to professional landscape design development, or those
who plan to enter a college of landscape architecture.
Students planning to transfer to a school of landscape
architecture should consult with landscape
architectural counselors to select acceptable transfer
courses.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

There is a particularly strong inter-connection between GIS technology
and Computer Aided Design (CAD) tools. As a result, there is an
incredibly persuasive argument for both GIS and Architecture programs to
cross-feed students and cross-pollinate curricula.

CAD tools are currently the primary software tools which architects use to
compose, present, and detail their design plans to clients, public agencies,
planners, supervisors, other architects and designers, engineers,
builders/contractors, etc.

CAD tools are similar in function and composition as their GIS counterparts. Both GIS and CAD tools fundamentally address space. Both GIS and CAD tools can be used for building/construction site selection, planning, and visualization. Real-world elements, objects, and phenomena can be virtually represented on a computer with both tools. Examples include a structural element such as a wall; a plot of land; a slope which a structure resides on; and adjacent elements such as streets, power lines, and sewer lines.

Indeed, the distinction between GIS and CAD tools is increasingly being blurred as indicated by the cross-industry feature and functionality now provided by major publishers of CAD and GIS software tools.(Ervin, [date unknown])   In other words, the formally distinct software tools from both fields/disciplines are adding features and functionality to cross their respective industry boundaries and to cater to a greater number of users [read: customers] and application domains.(Blue Sky Development, June 2005) Because of this, it is argued that familiarity with GIS concepts and principles would be invaluable to students/participants in the architectural field.

Geographic Information Systems

*Geographic information systems represent a quantum leap from earlier computer-aided mapping and design in at least two respects. First, they deal with "intelligent maps." For example, they not only "know" that a line of a particular color and thickness exists at some location on a map, but they also "know" that this line represents, say, a highway segment in a **real world** location and that this highway is classified as a freeway, has four lanes in each direction etc. The second contribution of GIS is the ability to perform overlays and spatial analysis, to be able, for example, to tell that the highway crosses a wetland area that is the habitat of a particular endangered species etc. In all fairness, I should say that a lot of natural cross-fertilization has happened between CAD and GIS to the point that the distinction between them is almost impossible to draw.*(Papacostas, C. S., 1995)

Architects can be defined as integrators of art and engineering. Any tool to facilitate this process can be invaluable to their professional skill set and their employing organizations. By having GIS *and* CAD skill sets, a student/participant in the architectural/planning field will have enough working knowledge to broaden the ways in which they communicate their plans, ideas, designs, and details. It will also provide them with a set of

skills to support their future employment and growth within any organization.

While actual study of architectural theory and principles doesn't usually require working knowledge of either CAD or GIS tools, it is certainly recommended because software tools are a major element of the best practices used in industry. By broadening the portfolio of knowledge and skills beyond just pure CAD tools, a student/participant in architecture can insulate themselves against any kind of technological movement or innovation that may require substantial "re-tooling" of their skill set. A similar scenario has actually occurred in the architectural field: The adoption of CAD tools over the last couple of decades in general architectural practice.

Unbeknownst among many architectural students who have yet to work in industry, there are still senior-level/principal architects who never personally mastered or regularly use CAD tools. Their skill set entails composing/rendering and editing site plans, designs, drawings, etc. by hand. The architects joining industry subsequent to them (and usually employed by them) are valuable to these "senior" architects because of their working knowledge and skills with modern design tools such as CAD.

Since it has been shown that CAD and GIS tool vendors are increasingly blurring the line that distinguishes the two, why not benefit future front-line architects with a broadened skill set that enables them to easily adapt and cope with any kind of technological movement and innovation in industry?

Additionally, the benefits derived from expanded domain knowledge and skills with CAD and GIS tools can have an immediate impact on the marketability and value of a student/participant. Not only does it demonstrate their desire to follow industry trends and innovation, which is critical in any design/engineering profession, it also represents another set of skills to allow for vocational flexibility.

Without a doubt, students/participants in the architectural field, whether it is "traditional" building-based architecture or landscape architecture, will highly benefit from working GIS knowledge and skills.(Landscape Information Hub, 2005)

CITED UTILIZATION IN ORGANZATION(S)

GIS Technicians Starting to be Retained by Architecture/Design Firms

Clark Nexsen Architecture and Engineering Design Firm describes a "Complete Services" approach to project design and offers ancillary services including Civil Engineering, Transportation Engineering, Telecommunications, GIS, and Environmental Engineering.(Clark Nexsen, 2005)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

Strong GIS Emphasis in Architectural Program

Los Angeles Trade Tech College's Architecture/Architectural Technology Program participants are exposed to an incredible diversity of software tools, including GIS tools, to support what they label as "Architectural Technicians."

Architectural Technicians are defined as workers who assist the architect in defining, creating, and organizing buildings, urban spaces and cyberspaces. They are in high demand in fields such as construction, drafting, estimating, building inspection, civil, electrical, mechanical and structural engineering, construction computer rendering, and computer-aided drawing.(Los Angeles Trade Tech College, 2005)

Their extensive program recognizes GIS as a major software technology to benefit students/participants in the architectural field. They include GIS skills certificates and certificates of completion in their A.A. and A.S. programs in Architecture and Architectural Technology.(Los Angeles Trade Tech College, 2005)

GIS Certificates for Architecture Students

A certificate in Geographic Information Technology is offered at Lexington Community College in Lexington, Kentucky. The program's curricula is tailored toward students/participants enrolled in their architectural technology program.(Lexington Community College, 2005)

OTHER NOTES

Classes in the Architecture program (either "specialization") are excellent candidates for inclusion as electives *in* the GIS program. Architectural technology is a sister technology to GIS technology; and they are becoming increasingly indistinguishable and cross-utilized. It would highly benefit a student in GIS to have fundamental architectural knowledge, especially with regards to site planning and CAD skills. GIS data and CAD data are currently interchangeable in many GIS and CAD software systems.

Art - Fine Art

SDMC DEPARTMENT

Art-Fine Art

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

1

SDMC DEPARTMENT DESCRIPTION

Description
The major in fine art consists of five "core" courses,
plus five courses which define an "area of emphasis."
Successful completion of the core courses indicates
that a student has achieved an operational
understanding of certain essential visual skills -- an
accomplishment which the department recognizes by
awarding a certificate of completion. Successful
completion of area-of-emphasis courses indicates that
a student has demonstrated the ability to apply and
expand these understandings to specific problems of
media and context. Students planning to transfer to
four-year schools should consult catalogs for those
schools. Some courses listed below as electives will
transfer only as electives, rather than as lower division
requirements.

Statement of Goals
This program is designed to provide students with a
foundation for the study of fine art and enables
students to obtain an Associate in Arts degree,
complete preparation for the major in fine art, and
transfer to a four-year school. The program also
prepares students to do advanced work in art on their
own or pursue a career in fields requiring visual literacy
and design expertise.

Program Emphasis
There are six areas of emphasis in the fine art major:
two-dimensional, design, three-dimensional, art
history, ceramics, and museum studies.

Career Options
The study of fine art will prepare students to pursue careers in fields requiring visual literacy and design expertise such as commercial graphics, animation, business communications, journalism, architecture, industrial design, interior and landscape design, stage design, curatorial design, art conservation, and gallery management.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

A major component of GIS is the visualization component.(Peng & Tsou, 2003) This is often a graphic visualization of the results of an analysis through the use of cartography.

Cartography or map making is widely considered to be an art and a science. It is through this intersection of technology and art that GIS merits consideration in the Art-Fine Art program.

Since the SDMC Art-Fine Art program has the stated goals of preparing its students/participants for commercial graphics, architecture, industrial design, and landscape design; GIS skills and knowledge could complement their existing skill set to make them more marketable for current and future employment.

The student/participant will be able to exploit GIS and spatial tools to generate thematic maps, graphics, displays, publications, and other materials for presentation graphics, designs, and conceptual layouts. Utilization is especially high in the desktop publishing sections of large private and public organizations.

For large-scale industrial art, structures, and buildings, the student/participant will be able to use the powerful GIS visualization tools provided in GIS technology to site, orient, and scale projects by overlaying surrounding imagery and existing structures. These tools can offer students/participants in the field the unprecedented ability to visualize the context of their sites in two and three dimensions, and aid in their evaluation and selection.

GIS skills and knowledge, in terms of these applications, can be thought of as premium value-added skill in their portfolio which can ultimately put the student/participant in a better position to benefit their organization and their position within it. For independent workers in the field, GIS skills and knowledge would represent a specialization that would better enable them to secure employment/commissions.

CITED UTILIZATION IN ORGANZATION(S)

In-House GIS Utilization at a Publishing Company

Design Presentation is a diversified desktop publication services company that has adopted GIS as one of the tools to meet their varying clients needs.(Design Presentation, 2005) As GIS utilization continues to expand into a diversity of fields and industries, and becomes more mainstream in its utilization, expect to see increased cross-over of GIS applications in such industries as graphic art/presentation graphics. As clients and the public grow increasingly accustomed to GIS technology and applications, expect organizations and clients to want some of the technology applied in their own projects and applications.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Cartography as a Fine Art

A strong argument is made for consideration of GIS cartography as a fine art in the following reference. The concept of cartography as an art form is considered. The reference also documents examples of maps produced using traditional and GIS methods. Significant arguments are given stating that GIS provides unique capabilities and methodologies for artistic expression. The paper concludes with a description of the benefits of GIS cartography as a fine art to the GIS community and the community at large.(Endelman, 1999)

OTHER NOTES

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Biology

SDMC DEPARTMENT

Biology

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

5

SDMC DEPARTMENT DESCRIPTION

Biology is a natural science that focuses on physical and chemical processes of living organisms. This discipline explores how organisms acquire and use energy to maintain homeostasis, how they reproduce, and how they interact with each other and their environment. Scientific processes are emphasized as a means of answering these biological questions. Biologists rely heavily on a chemistry foundation since living organisms are chemical systems.
The Biology program serves three areas of study. Biology provides a broad background of studies for the biology major preparing for transfer to a four-year institution. The biology program offers support courses in human anatomy, human physiology, and general microbiology which may be used to satisfy prerequisites for nursing programs and other allied health fields. The biology program provides courses in natural science to fulfill general education requirements.
The following list is a sample of the many career options available for the biology major. A few of these require an associate degree; most require a baccalaureate degree and some require a graduate level degree: agricultural consultant, animal health technician, biotechnology technician, dentist, environmental consultant, field biologist, forester, horticulturist, high school or college teacher, marine biologist, microbiologist, public health technician, physician, pharmaceutical researcher, research biologist, and veterinarian. In addition, a background in biology may be required for the following: registered nurse, physical therapist, respiratory therapist, dental assistant, health information technician, medical

technician, physician's assistant and optometrist.
The three associate degrees in biology require
completion of the courses listed below. Additional
general education and graduation requirements for the
associate degree are listed in the catalog.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The primary benefit a student/participant in biology will realize by
including GIS and general spatial knowledge in their personal skill set is
general competency with powerful tools to support documentation & data
collection, analysis, presentation, and visualization of spatially-associated
data related to research applications within the field.

Powerful arguments and sophisticated presentations of data can be made
with GIS tools to support and broadcast research data on studies that
involve any kind of space and/or time component. A research biologist
studying disease might be interested in using GIS to track, monitor, and
map observations and outbreaks. A biologist studying flora and fauna
may want to track, monitor, and document species number and diversity.
Another biologist may want to track biological specialization, spread,
location, changes over time, and other variables to prove/disprove
hypotheses. The power and utility of GIS is significant because of its
varying applications as a tool to support research and analyses with data
having a space/time component.

With a GIS tool, the student/participant will be able to generate powerful
reports or construct persuasive arguments in order to influence,
recommend, or direct policy based on observed phenomena or
documented scientific evidence. Combined with associated reports,
presentations, and/or publications, the student/participant will be able to
provide much stronger documentary evidence supporting their
positions/arguments. In this sense, GIS skills and knowledge can be
thought of as an enhanced research and presentation tool. These
applications of GIS will support academic and field researchers, as well as
organizational managers and directors.

CITED UTILIZATION IN ORGANZATION(S)

GIS Application Examples in Conservation Biology

The "GIS Lounge" is a Web resource that has some example links to GIS
applications and solutions in conservation biology. Some examples

include a "bioregional information system" which consists of a comprehensive GIS database of biophysical, social, economic, and cultural data; and "InfoRain" which consists of data related to North American rainforest regions at multiple scales.(GIS Lounge, 2005)

GIS Application Examples at the CDC

The U.S. Centers for Disease Control (CDC) gives an overview of GIS utilization in various public health applications include health statistics, a toxic substance registry, and disease registry.(CDC, 2005)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Course for Field Methods in Environmental Science

St. Lawrence University in Canton, New York lists the following description in their course catalog for Biology 241: Field Methods for Environmental Scientists:

> *This interdisciplinary course is intended for students interested in environmental science (e.g., environmental studies, biology, geology or chemistry majors or minors). We will familiarize students with experimental design and statistics and train students in a variety of field techniques including map and compass work, basic surveying techniques, and water, soil, vegetation and faunal sampling. The course will also introduce students to the use of Geographic Information Systems (GIS) for research in environmental science. By the end of the semester, students will have a working knowledge of ArcView GIS software and will have experience creating and managing GIS projects. Students will increase their familiarity with local natural habitats and gain a big-picture understanding of environmental science as an interdisciplinary endeavor. Students interested in developing highly marketable GIS and field skills in the context of environmental research should consider taking this course.*(St. Lawrence University, 2005)

GIS Courses for an Applied Biotechnology Program

Ventura College in Ventura, California focuses on applied biotechnology applications in their GIS Agri-Science Program. They offer details of their program at their Website link and describe several agri-science career

opportunities including Agribusiness, City Planning, Range Managers, Soil Conservation, Farm Data Manager, Ecologist, Hydrologist, Field Sensor Monitor, Enforcement/regulation.(Ventura College, 2005)

Biology Course Touting GIS as a Research Tool

GIS is actually taught as a biological research tool in the University of Missouri-St. Louis' Biology 483 course: Applications of Geographic Information Systems (GIS).(Loiselle, 2002)

Biology Emphasis in a GIS Program

Due to the utility of GIS to support biology, Foothill College's GIS program includes biology as a "focus area" in which GIS technology can be directly applied in a student's/participant's program. Besides further emphasizing the cross-disciplinary nature of GIS, the school is advantageously cross-feeding students in a broader more enriching program of study.(Foothill College, 2005)

OTHER NOTES

Classes in the Biology program that emphasize research, field methods, or data collection and analysis are excellent candidates for inclusion as electives *in* the GIS program. It is a great way to provide students in the GIS program broad exposure to and an understanding of a field/area with rich spatially-associated data.

Black Studies

SDMC DEPARTMENT

Black Studies

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

2

SDMC DEPARTMENT DESCRIPTION

A multidisciplinary curriculum offering courses in American Institutions, Humanities, Social Sciences, and Learning Skills. The program builds a positive understanding and knowledge of the history, culture, and contributions of Africans and Afro-Americans. All students benefit from courses in Black Studies, especially those who pursue careers in social sciences, education, law, counseling, journalism, social work, health care professions, teaching, business, and public administration.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The separate programs of Anthropology and Black Studies have similar applications, scope, and justifications for GIS curricula inclusion.

Black Studies/African American Studies, as described in the SDMC Course Catalog, is a discipline within the humanities and social sciences. As such, GIS can be used to support interdisciplinary research in the area. Generally, GIS would augment existing research tools by being able to aggregate, chart, display, analyze, and visualize data related to location and/or time as it would apply to African-American demographic studies and black history.

In terms of black studies in modern-day America, there are examples available of using GIS to study social and urban demographics and distributions.(Penn State, 2005). Harnessing readily available CENSUS and statistical data, GIS maps and analysis can illustrate and provide very strong and provocative arguments for social and societal change in terms of current and historical socio-economic inequities suffered by black Americans.

In terms of black history, much data are available on the trans-Atlantic slave trade, the associated slave ship routes and voyages, and the resulting Diaspora of native African peoples.(Notre Dame, 2005) With GIS, historical data can be used to interactively map, display, and track movements over time. Ship logs, data on geographic regions, and other associated records/data from a variety of sources, and in a variety of formats, can be combined to create a powerful customized GIS tool to interactively study this significant part of world history.

Many of the same arguments for GIS utilization as a research tool for students/participants in the Black Studies program are the same for the Social Sciences program.

(see Social Sciences)

CITED UTILIZATION IN ORGANZATION(S)

GIS Used to Study Disease and Demographics

The US Centers for Disease Control uses GIS technology to make an interactive atlas of reproductive health issues and statistics alongside CENSUS-derived population demographics, including race and ethnicity.(CDC, 2005) By being able to combine several forms of data from separate sources, researches can use GIS to support their arguments---in this case, about the state of public reproductive health and its associated factors.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Utilized to Study Inner-City Segregation

A paper by Penn State researcher Stephen Matthews entitled "GIS and Spatial Demography" highlights the strength of GIS in demographic analysis. An application example given is its use in studying inner-city racial and socioeconomic segregation.(Matthews, October 2003)

GIS Utilized to Study the Diaspora

The University of Florida's Anthropology Department has been successful in applying GIS and other spatial technologies in studying data related to

the Diaspora. Elements of their study include DNA analysis, aerial photography and satellite imagery, forensics, and ethnohistory. GIS appears to be the "glue" to unify these diverse forms of data.(University of Florida, 2005)

OTHER NOTES

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Building Construction Technology

SDMC DEPARTMENT

Building Construction Technology

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

4

SDMC DEPARTMENT DESCRIPTION

This program is designed for the student who is
interested in a construction-related career. This
program is designed for the student who is interested in
a Construction Inspection or Construction Management
career. Program planning should occur with the
assistance of a department member. All courses have
been designed to be taken sequentially.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

Many of the arguments in support of adoption of GIS curricula for the
Architecture program at SDMC overlap with the ones for the Building
Construction Technology program.

(see Architecture)

A *very* strong, forward looking, and convincing argument for GIS and
similar computer knowledge and skills by the building construction
industry is provided by the respected *Habitat* journal. *Habitat* is the
Journal of the Centre for Education in the Built Environment and is based
in Cardiff, Wales.

> **Building Construction**
> *The range of computer use in all kinds of construction activities is
> vast and increasing all the time. The construction industry has for
> a number of years been using CAD systems to help design
> buildings and elements within them. As such, most students of
> construction and associated disciplines are now at least
> conversant with the technology. However, computer-based
> packages are becoming available for a greater variety of
> applications specifically associated with the construction process*

as opposed to the design and prediction software familiarly used by those involved in the design of buildings.

There has been an explosion of specific software packages that are designed to help provide financial control of construction projects. These range from measurement and bills of quantities, sometimes linked to CAD, to estimation and costing. The increased use of technology also allows a greater degree of collaboration between members of the construction team. Those building professionals involved with the construction process are also increasingly using standard software such as spreadsheets for a range of management activities, especially the control of resources.

From the 1970's onwards, project and construction management has made use of computer based management systems in order to control the complexities of construction projects. Since that time, the development of user friendly software to forecast, plan and organize complex operations has resulted in the widespread use of computer systems in all aspects of construction management.

At site level, computer technology is employed to ensure accuracy, quality, communication and control, for example in the form of hand held modems, surveying instruments and theodolites. In addition, GIS is now being used for a whole range of construction applications ranging from marketing to purchasing and personnel functions.

Educationally, the development of multimedia computer simulations will enhance student appreciation of the building process to a far greater extent.(Habitat, [date unknown])

By adopting GIS curricula in the Construction Technology program, the department will be able to augment their students' practical knowledge and skill set training.

Generally, students/participants in the program who plan to pursue careers in construction planning, supervision, and operations may benefit the most from GIS technology knowledge and skills. It will also benefit them should they wish to pursue an advanced degree in such fields as architecture or civil engineering. This knowledge and skill set can benefit them at any stage of their career and ensure they are up-to-date with state-of-the-art trends in technology and practice.

CITED UTILIZATION IN ORGANZATION(S)

GIS in Construction and Engineering

The Consultancy within Engineering, Environmental Science and Economics (COWI) is a large international consulting firm of engineers, biologists, geologists, economists, surveyors, anthropologists, sociologists and architects which undertakes consultancy and planning projects.

They list Geographic Information Systems (GIS) and Land Information Systems (LIS) as integral elements of construction and building technology.(COWI, 2005) This leading firm has readily embraced GIS technology as a significant tool in meeting their clients' needs. It can be inferred that, with knowledge and skills in a cutting edge technology such as GIS, the student/participant in the industry will have greater growth and earnings potential.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Courses to Support the Design/Construction Fields

George Mason University's Department of Civil, Environmental and Infrastructure Engineering offers GIS curricula to support construction design, planning, and management.(George Mason University)

Reviews of GIS offerings at other educational institutions with constructional technology programs reveal that it is generally accepted as a high-end and specialized skill for students/participants who plan on seeking continued education or advanced degrees in areas such as construction management, architecture, and civil engineering.

OTHER NOTES

*

Business
Administration

SDMC DEPARTMENT

Business Administration

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

4

SDMC DEPARTMENT DESCRIPTION

Prepares the student for transfer to a four-year college
through maximum use of equivalent courses. It also
provides a foundation for entry into business.(San Diego Mesa College,
2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

GIS technology and tools are wonderful presentation, visualization, and
analysis tool for marketing. By combining existing geospatial data such as
CENSUS demographics, county assessor's data, and location data of
existing businesses and structures, a detailed and powerful market analysis
can be performed.

What is significant is GIS technology's applicability to several stages of
the market analysis including identification of target markets based on
demographic and existing sales data; business site selection based on
analyses of office locations, suppliers, distribution centers/sellers, property
values, traffic, etc.; and sales and productivity reports by geographic
region, customer groups, or individual customers.

GIS is an unprecedented tool for business reporting and analysis. It can
assist directors, managers, and front-line workers in gauging and modeling
the success and direction of their business endeavors at any stage.

CITED UTILIZATION IN ORGANZATION(S)

GIS as a Management and Decision Support Tool

Collaborating researchers at a conference sponsored by the Naval Post
Graduate School offer a business management "call for papers" under the

title "GIS and Decision Support." Clearly GIS and other related technologies are viewed as cutting-edge tools for management. Note the partial description of their investigation:

> [The goal of the program is to] *investigate the interface between GIS technology and management decision making. The goal of* [decision support systems] *DSS in general is to deploy computing technology to significantly improve the quality of critical strategic and tactical decisions. GIS technology provides ample opportunities for extending the scope and effectiveness of decision support for the many real-world management problems with an explicit spatial-temporal context.*
>
> *A secondary objective of this Minitrack is to promote interdisciplinary interest between the* [Management Information Systems/Science] *MIS and GIS research communities. MIS researchers are just beginning to realize the extent to which GIS can enhance traditional information systems whereas GIS researchers have been trying for years, with limited success, to bring attention to the unique spatial aspects of many traditional management problems. This forum presents a window for a rich exchange of perspectives.*(Marble, 1999)

Example GIS Business Applications

It may be worthwhile to note that there is an invaluable online resource available that represents a compilation of GIS applications and information in the context of business.(GIS for Business Resource Guide, 2005)

By exposing students/participants in business administration to GIS curricula, the program will augment their student's/participant's existing knowledge and skills set, and provide them with invaluable building blocks to further their education goals and/or assist them in advancing to positions of greater responsibility and impact.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS and Business Departments Collaborate to Develop Marketing & Decision Support System

Central Michigan University's departments of geography and business administration collaborated to create a lasting interdisciplinary

relationship involving GIS and its use as a marketing decision and support system. By adopting GIS, Central Michigan University's College of Business was able to enhance the reputation of its Marketing Research Office. These innovations creating a positive dynamic which also increased interest in its associated extended studies programs which cater to adult/career learners.(Hassen, 2003)

Business Emphasis in a GIS Program

Due to the utility of GIS to support business, Foothill College's GIS program includes business as a "focus area" in which GIS technology can be directly applied in a student's/participant's program. Besides further emphasizing the cross-disciplinary nature of GIS, the school is advantageously cross-feeding students in a broader more enriching program of study.(Foothill College, 2005)

GIS Specialization in Management Information Systems

The University of Central Arkansas' bachelor's program in Management Information Systems (MIS) has a GIS specialty track for its students. The description includes the following:

> *The GIS/Spatial Systems Track is designed for MIS majors who wish to prepare for jobs working with electronic mapping systems. These systems are used extensively by federal, state, and local government agencies. Utility companies which provide electric power, natural gas, water, sewer, cable, and telephone almost all use these systems. Many other employers are also interested in GIS/Spatial system technologies.*(University of Central Arkansas, 2005)

Business Applications in GIS Specialization

Fort Hays State University includes GIS curricula in a business specialization track for students/participants in their mathematics and computer science program.(Fort Hays State University, 2005)

OTHER NOTES

The separate programs of Business Administration and Business Management generally have the same applications, scope, and justifications for GIS curricula inclusion.

Business Management

SDMC DEPARTMENT

Business Management

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

3

SDMC DEPARTMENT DESCRIPTION

Intended for the student who wishes to plan a program
in preparation for a business occupational area of his/
her own choice. Flexible course selection is emphasized
to enable students to achieve their specific
educational, vocational and personal goals. Students
planning to transfer to a four-year college or university
should select the Business Administration major.(San Diego Mesa College,
2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The separate programs of Business Administration and Business
Management generally have the same applications, scope, and
justifications for GIS curricula inclusion. However, as flexibility of
course selection is emphasized for the vocational and personal goals of the
students/participants in the Business Management program, inclusion of
GIS curricula may be even more valuable for contributing to the
student's/participant's base set of background knowledge, tools, and life
skills.

(see Business Administration)

CITED UTILIZATION IN ORGANZATION(S)

(see Business Administration)

Example GIS Business Applications

It may be worthwhile to note that there is an invaluable online resource available that represents a compilation of GIS applications and information in the context of business.(GIS for Business Resource Guide, 2005)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

(see Business Administration)

OTHER NOTES

The separate programs of Business Administration and Business Management generally have the same applications, scope, and justifications for GIS curricula inclusion.

Chicano Studies

SDMC DEPARTMENT

Chicano Studies

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

2

SDMC DEPARTMENT DESCRIPTION

The Chicano Studies program provides an
interdisciplinary approach, examines the interaction of
the Chicano with the majority culture in a bilingual,
bicultural setting. Chicano Studies courses are taught
in English. The Chicano Studies curriculum is designed
to meet general education requirements for all
students. It also prepares students for upper division
work toward a B.A. in Chicano Studies and professional
fields, e.g., social sciences, humanities, law, teaching,
social work, and public administration. Chicano Studies
courses transfer to four-year colleges and universities.(San Diego Mesa
College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The separate programs of Anthropology and Chicano Studies generally
have the same applications, scope, and justifications for GIS curricula
inclusion.

The Chicano Studies program directly emphasizes an interdisciplinary
approach. GIS can be used to support interdisciplinary research by acting
as the electronic "glue" between disparate data sources such as the US
CENSUS Bureau, state and local agencies, and data collected by
organizations and advocacy groups. Generally, GIS would augment
existing research tools by being able to aggregate, chart, display, analyze,
and visualize data related to location and/or time as it would apply to
Chicano demographic studies, Chicano history, and trends.

In terms of Chicano studies, GIS can be used to study such areas as social
and urban demographics and distributions. CENSUS and statistical data
combined with GIS maps and analysis can be used to analyze and

illustrate current and historical socio-economic inequities suffered by Chicanos/Chicanas. It can also examine the complicated roles of geography, family, faith, politics, etc. in Chicano life.

In terms of Chicano history, a diverse array of research and ethnographic data can be combined into a GIS to study Chicanos/Chicanas over time and space. GIS can also be used to interactively analyze and display movement, dispersion, and demographics for further study and analysis. In these applications, GIS technology and knowledge are used to augment existing research and analytical tools.

Many of the same arguments for GIS utilization as a research tool for student/participants in the Chicano Studies program are the same for the Social Sciences program.

(see Social Sciences)

CITED UTILIZATION IN ORGANZATION(S)

GIS Used in Chicano/Chicana Field Research

The Julian Samora Research Institute uses GIS tools for Latino/Latina ethnographic research in US rural communities and analyzes Chicano/Chicana interest and success in social sciences research.(Garcia, 2001)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Used in Tracking Farm Worker Health

Dr. Barbara Herr-Harthorn, a researcher attached to the UCSB Center for Chicano Studies, is using public participation GIS to monitor Mexican-origin farm workers' health and the associated factors such as pesticide drift.(Herr-Harthorn, 2005)

OTHER NOTES

*

Computer Business Technology

SDMC DEPARTMENT

Computer Business Technology

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

5

SDMC DEPARTMENT DESCRIPTION

**Information Management
Technology**
The role of the information and records manager in
information technology is selection and design of
systems, equipment, control, and maintenance of a
records center.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The SDMC Computer Business Technology Information Management
Technology program prepares students/participants for roles in
information technology (IT)/information systems (IS) management. A
significant portion of an IT/IS manager's responsibilities encompass
selection, maintenance, and administration of database management
systems (DBMS).

Geographic Information Systems (GIS) can be considered to be a highly
specialized subset of information systems technology. Past and recent
evidence is pointing to increased utilization of GIS technology in most
organizations as a decision support system.(Sitzen, June 2004) Because of
the rapid expansion and adoption of the technology, technicians and
administrators who are familiar with GIS deployment and maintenance are
increasingly being sought. Additionally, current IT/IS staff at various
organizations are sent to costly "guerilla-style" (crash course) training/
seminars in GIS technology and administration to quickly ramp up their
skill set in order to support their organizations needs.

Because of GIS's increased utilization and the impending shortfall of
qualified technicians/administrators with GIS knowledge and skills, there
are very strong arguments for students/participants in the Information
Management Technology program in Computer Business Technology to

adopt GIS curricula in their program. The outcome will be an enriching cross-disciplinary skill set for the student/participant, and increased job and promotional opportunities.

CITED UTILIZATION IN ORGANZATION(S)

GIS Housed in IT/IS Departments in Organizations

Many public and private organizations host their GIS infrastructure and administration within their IT/IS departments. The City of Des Moines, Iowa provides their diverse array of GIS services to their city staff and citizens through their IT and Engineering departments.(City of Des Moines, 2005)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS for MIS Specialization

The University of Central Arkansas' bachelors program in Management Information Science/Systems (MIS) has a GIS specialty track for its students. The description includes the following:

> *The GIS/Spatial Systems Track is designed for MIS majors who wish to prepare for jobs working with electronic mapping systems. These systems are used extensively by federal, state, and local government agencies. Utility companies which provide electric power, natural gas, water, sewer, cable, and telephone almost all use these systems. Many other employers are also interested in GIS/Spatial system technologies.*(University of Central Arkansas, 2005)

OTHER NOTES

Classes in the Computer Business Technology: Information Management Technology program are excellent candidates for inclusion as electives in the GIS program. Database organization, management, and concepts are essential to IT managers and are also key considerations of managers and administrators of Geographic Information Systems.

Computer and Information Sciences

SDMC DEPARTMENT

Computer and Information Sciences

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

5

SDMC DEPARTMENT DESCRIPTION

Prepares students for employment in the rapidly
expanding field of Computer and Information Sciences
and offers the skills required to function effectively in
various occupations and professions requiring the use
of computers. Required courses focus upon the use and
functioning of the computer and relate the general
study of the computer with studies of specific
languages, enabling the student to combine computer
hardware and software to process data into information.
Upon completion of this curriculum, the student should
have the capability to apply computer technology to
diverse business and professional environments and be
qualified for employment as an entry-level programmer
in the computer and information sciences industry or
transfer to 4-year institution.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

GIS programming and customization received a huge boost from major
commercial and open source distributors of GIS software with the release
of powerful GIS programming libraries and application programming
interfaces. An excited and supportive developer community also
contributed to the success of custom GIS programming.

With GIS's increased acceptance and utilization within many industries
and areas, there is an ever-increasing need and demand for GIS
programmers.

It is well known that most programmers, in time, specialize in specific
application areas using specific programming tools and
languages.(Princeton Review, 2005) Many times these specializations

become problematic for a programmer whose supporting organization decides to adopt different programming languages, tools, etc. It is very important for a programmer to keep up with industry trends and successful implementations of software applications. It is also important for a programmer to have relevant knowledge and an in-demand skill set.

There is an extremely solid case for programmers to have general GIS knowledge and programming skills. Fundamental knowledge of the technology is a prerequisite to GIS programming.

In this era of technological outsourcing and corporate downsizing, it is exciting to observe a technology that is actually gaining precedence in industry (with business applications, scientific applications, etc.) and within mainstream life (examples include Google Earth, Microsoft Expedia, GPS car navigation systems, etc.).

By gaining an understanding of GIS technology, a student/participant in the Computer/Information Sciences program will have an incredibly valuable commodity that will help them with their vocational and future employment/promotion opportunities.

CITED UTILIZATION IN ORGANZATION(S)

Study Points to GIS Programmer Shortage

The Geographic Resources Center at the University of Missouri at Columbia has a study documenting utilization, skills, and attributes of GIS programmers in organizations.(University of Missouri, [date unknown]) The study notes that as GIS is increasingly adopted in industry and in organizations, personnel issues will become significant.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Certificate Program Between Geography and Computer Science Departments

Many college 2-year, 4-year, and graduate programs in computer science/information science now have curricula with a strong GIS component---particularly, GIS programming courses.

San Diego State University has a dual-department GIS Certificate program offered between the geography and computer science departments. (SDSU Computer Science, 2005)

GIS Certificate for Computer Information Technology Program Students

A certificate in Geographic Information Technology is offered at Lexington Community College in Lexington, Kentucky. The program options include curricula tailored toward students/participants enrolled in their computer information technology program.(Lexington Community College, 2005)

Courses in GIS Applications for Business for Math and Computer Science Students

Fort Hays State University includes GIS curricula in a business specialization track for students/participants in their mathematics and computer science program.(Fort Hays State University, 2005)

OTHER NOTES

Classes in the Computer and Information Sciences program are excellent candidates for inclusion as electives in the GIS program. Computer science, technology, and programming are invaluable skills in the GIS field. Businesses, organizations, and institutions are already trying to build customized applications using GIS and other spatial technologies, and this requires skilled and competent computer professionals.

Health Information Technology

SDMC DEPARTMENT

Health Information Technology

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

1

SDMC DEPARTMENT DESCRIPTION

This program is designed to meet the increasing need
for professionally trained Health Information
Technicians in acute care hospitals, clinics, long term
care, and other health care facilities as well as
governmental and private agencies. The two-year A.S.
degree program provides emphasis on record storage
and retrieval, quantitative analysis, coding and
abstracting, legal aspects of health records, health care
statistics, supervision of department personnel, and an
introduction to quality assessment, utilization review,
and risk management.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

It is not inconceivable that health records and similar data will be
aggregated and organized into a spatial database some time in the near
future.

Because of this, it may benefit students/participants in the Health
Information Technology program to have some GIS background.
Depending on the goals of the student/participant, a GIS knowledge and
skill set may provide an avenue for promotion, specialization, or
continuation of their education.

*The tremendous potential of GIS to benefit the health care industry
is just now beginning to be realized. Both public and private
sectors are developing innovative ways to harness the data
integration and spatial visualization power of GIS. The types of
companies and organizations adopting GIS span the health care
spectrum--from public health departments and public health policy*

and research organizations to hospitals, medical centers, and health insurance organizations.(ArcUser, April 1999)

Generally, GIS would be useful to a student/participant in this field/area who pursues a research role or plans to further their education/training.

CITED UTILIZATION IN ORGANZATION(S)

GIS Applications in Public Health

GIS in Public Health Practice discusses cutting-edge GIS applications in public health including disease mapping, spatial analysis, and health care planning and policy.(Craglia & Maheswaran, July 2004)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

Applied GIS: Medical Informatics

There are many educational and medical research institutions that are now exploring applications of "medical informatics." Medical informatics can be described as the science of medical information, its organization, and its processing. The Mount Sinai School of Medicine cites several medical informatics programs and initiatives.(Mount Sinai School of Medicine, 2005)

OTHER NOTES

*

Interior Design

SDMC DEPARTMENT

Interior Design

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

4

SDMC DEPARTMENT DESCRIPTION

This program provides the basic aesthetic and business
concepts of interior design for students interested in an
interior design career. The interior design program
offers two educational options: option one is a
Certificate of Achievement, option two is an Associate
in Science Degree.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

Fields such as site planning, drafting, architecture, and interior design all
fundamentally address space. It is not uncommon to find these
fields/areas addressed together or housed in the same department or
organization. In industry, many interior designers are employed in
engineering and architectural firms.(ISeek, 2005)

Because fundamental tasks in the interior design field consist of planning
and designing spaces, software such as Computer Aided Design (CAD)
tools are often used. The growing convergence of CAD and GIS software
tools is extensively cited in the section addressing the SDMC Architecture
program. Thus, much of the argument for inclusion of GIS curricula in
the interior design program is similar to the argument for the architecture
program.

(see Architecture)

A reinforcing argument for GIS curricula in interior design would be to
provide students/participants in the interior design field the opportunity to
gain fundamental knowledge of and skills with a cutting-edge technology.
Additionally, if one takes into consideration the outlook for GIS and other
spatial technologies, the additional knowledge and skill set will prove to
be beneficial for any vocational path.(Sietzen, June 2004)

CITED UTILIZATION IN ORGANZATION(S)

GIS Utilization at Design/Planning Firms

There are many examples of GIS utilization at combination planning, engineering, architecture, and interior design firms.(CannyLink, 2005.) GIS skills and knowledge would benefit a candidate and current employees within such firms because they would offer management the opportunity to cross-utilize the worker.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

CAD in Interior Design Programs

Architectural-based drafting and CAD are commonly required curricula in an interior design program.(Virginia Western Community College, 2005) Since GIS and CAD are closely related (see Architecture), there is ample justification for GIS curricula inclusion.

GIS Tools Made Available for Interior Design Students

The interior design program at Iowa State University gives its interior design students access to 3-D modeling, CAD, and GIS labs for their coursework and projects. The program at Iowa State's College of Design unabashedly identifies and emphasizes the similarities among many of the spatial design fields/areas.(Iowa State University College of Design, 2005) With the rapid convergence of tools and practices in industry, this may prove to be a very forward-looking program.

OTHER NOTES

*

Languages

SDMC DEPARTMENT

Languages

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

2

SDMC DEPARTMENT DESCRIPTION

Program provides training in the fundamental skills of understanding, speaking, reading and writing the language, and increases one's familiarity with the English language. From a vocational standpoint, the curriculum will provide a student with skills useful in translating, interpreting, teaching, linguistic or literary research, music, foreign trade, or missionary work. The major requires 26 units in the same language, unless the student has completed two years of a language in high school (with a "C" average or better) and takes 10 units of an intermediate course at the college. In this case, the department will determine the courses necessary to complete the requirements.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The primary benefit a student/participant in languages will realize by including GIS and general spatial knowledge in their skill set is general competency with powerful tools to support documentation & data collection, analysis, presentation, and visualization of data primarily related to research applications within the field.

Powerful arguments and sophisticated presentations of data can be made with GIS tools to support and broadcast research data on studies that involve any kind of space and/or time component. Many existing studies in linguistics, language distribution and mapping, and language evolution are conducting with GIS tools. This specialized application area is called geolinguistics or dialectal geography.(Rivero et al., December 2002)

The power and utility of GIS is significant because of its varying applications within the field/area as a tool to support research based on

location and/or time. Combined with associated reports, presentations, and/or publications, the student/participant will be able to provide much stronger documentary evidence supporting their positions/arguments. In these examples, GIS skills and knowledge can be thought of as an enhanced research and presentation tool. These applications of GIS will primarily support academic and field researchers.

CITED UTILIZATION IN ORGANZATION(S)

GIS Used for Making Language Atlases

In a specific application of GIS, researchers map the spatial distribution of languages forming a digital linguistic and ethnographic atlas of South American regions.

> *In 1994, the Institute of Linguistics and Philology-Universidad Nacional de San Juan (INILFI Manuel Alvar) started the Cuyo's Linguistic and Ethnographical Atlas (AleCuyo) project to evaluate linguistic aspects of a study area in Argentina. The area under study-the New Cuyo-includes the provinces of San Juan, Mendoza, San Luis, and La Rioja and covers an area of more than 400,000 square kilometers.*

> *Linguistic geography, also known as geolinguistics or dialectal geography, is a research method used by several linguistic disciplines. It places linguistic phenomena in spatial context to analyze the possible relationships between language and the geocultural environment. Phonetic, morphological, syntactical, and semantical data-collected by means of questionnaires-are displayed on maps. Different maps are drawn for each problem or aspect of the language under study.*(Rivero et al., December 2002)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Used for Making Online Language Atlases

The linguistics department at Stockholm University in Sweden exploits GIS tools to produce fascinating, interactive, and Web-based GIS maps of little-known languages.(Stockholm University, 2005)

LANGUAGES

OTHER NOTES

*

Liberal Arts

SDMC DEPARTMENT

Liberal Arts

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

3

SDMC DEPARTMENT DESCRIPTION

Designed for students who wish a broad knowledge of
liberal arts. This flexible major can be taken by
students who wish to earn a general associate degree.
It is also appropriate for transfer students. Those
planning to transfer to a four-year institution should
consult a counselor.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

Much of the argument for GIS within a general liberal arts education lies
in its utility as an inter-disciplinary tool to support research/investigations,
analysis, and presentation. This clip from an article by Dana Triplett
offers a broad and convincing argument on why a student in the liberal
arts would benefit from a GIS skill set and general spatial knowledge:

> *A liberal arts education empowers students to approach complex
> data with confidence, evaluate it, impose order on it or appreciate
> its ambiguity, then discuss it and creatively elaborate on it - in
> short, the liberal arts graduate can turn data into well-presented
> information. Geographic Information Systems (GIS), offers liberal
> arts college students and their teachers and mentors a new tool to
> apply to this transformation: a high-tech suite of applications
> designed to reveal the hidden narratives of complex data. As
> liberal arts institutions across the country work to constructively
> integrate technology across the curriculum, GIS has emerged as a
> useful vehicle for encouraging the development of spatial analysis
> skills in a variety of disciplines.*

> *Given its promise as a tool that can help both students and faculty
> analyze complex data and eloquently present the results of their
> research, GIS would seem to be a good use of technology within*

the framework of the goals of the liberal arts curriculum. Whether thinking in terms of teaching GIS or teaching with GIS, the technology also offers pedagogical benefits. It can lend itself to a variety of learning styles, and may also help students learn teamwork and critical thinking skills. In addition, teaching students to use GIS allows them to develop the computer and technical skills that are in demand in the workplace, and that liberal arts institutions are often criticized for neglecting. Finally, if you are looking to share your research with other academics or with the larger community, the sophisticated yet clear visual representations that can be generated by a GIS are an excellent place to start.(Triplett, 2005)

Many of the same arguments for GIS utilization as a research tool for students/participants in the Liberal Arts program are the same for the Social Sciences program.

(see Social Sciences)

CITED UTILIZATION IN ORGANZATION(S)

GIS: A Powerful Tool for the Liberal Arts

Because of the cross-disciplinary nature of the study areas that are addressed by the liberal arts, GIS technology and spatial knowledge have been flagged as a very valuable tool to aid in education and research.

A lot of recent research and emphasis has been placed on teaching with GIS in the liberal arts.(Hensley-McGaffey, September 2004) It may be useful and instructive for students in a liberal arts program to gain some knowledge and understanding of this growing technology so that they may be adequately prepared to tackle projects, research, and analysis within the many diverse fields/areas.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Specialization for a Liberal Arts Major

The University of Northern Iowa offers liberal arts major the option to specialize in GIS.(University of Northern Iowa, 2005) By having this option available, their program verifies that GIS is a powerful and useful cross-disciplinary research, analysis, and presentation tool.

OTHER NOTES

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Marketing

SDMC DEPARTMENT

Marketing

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

5

SDMC DEPARTMENT DESCRIPTION

Designed for the student interested in marketing as a
career and tailored to develop competency in
merchandising, retailing, and wholesaling, in both
large and small businesses. Students are encouraged to
work part-time while attending college. The student
can obtain credit for working by enrolling in Marketing
270. Successful completion should lead to a full-time
position or serve as a foundation for further education.
Students planning to transfer to a four-year college or
university should select the Business Administration
major.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

There is a particularly strong argument for GIS curricula inclusion in a
marketing program of study.

GIS technology fundamentally addresses location and data associated with
location. Additionally, GIS's analysis, visualization, and presentation
tools make it an incredibly powerful tool for a marketer.

Many of the arguments for GIS also apply to the business administration
program. That being said, the argument for the marketing program is
actually stronger.

In industry and academia, it is the marketer who collects, analyzes, and
presents their data for their supervisors, managers, and directors. In this
sense, GIS represents an indispensable tool for a front-line worker or
member of an organization.

The text-book example of a GIS application is the example of market analysis:

> Businesses use GIS for a variety of market analyses, for example to evaluate whether or not there is a large enough nearby population with favorable demographic characteristics to support a new retail store at a given location.(Kay, [date unknown])

By being able to aggregate and analyze several different forms of data based on location, strong arguments can be made on organizational decisions; and a clear and convincing picture of organization's current status can be presented.

CITED UTILIZATION IN ORGANZATION(S)

GIS is an Indispensable Tool for the Professional Marketer

GIS in marketing has been recognized as a hugely powerful tool to study and analyze markets (market intelligence).

Robert Seiner of the Data Administration Newsletter discusses some marketing applications of GIS including identifying customers, turning business experiences into better decisions, geospatial data mining, customer relationship management: knowing the target audience, and retail site selection. He discusses how public and private demographic data, market data, market research, and operational data can be assimilated into a GIS for hugely powerful analysis and decision-aiding tools.(Seiner, 2000)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Minor for Marketing

Many universities have "eMarketing" concentrations/classes in their marketing programs(Langford, 2002). GIS is generally described as a major tool for technological-assisted marketing.

The University of Montana's marketing program has proposed a minor program in business Geographic Information Systems. The program consists of classes in their GIS (hosted out of their geography department), management, and marketing programs.

The Business Geographic Information Systems (GIS) minor fits well within the institution's mission as it takes an interdisciplinary approach to study and service to the community. The proposed minor encourages the use of information technology in the advancement of student learning, a role defined in the University's mission. It also promotes the integration of theory and practice, and there are direct applications of the program content in increased career opportunities for graduates with this specialization. The Business Geographic Information Systems (GIS) minor is consistent with the availability of resources and the institutional mission.(University of Montana, [date unknown])

GIS/Marketing Certificate Program

Cypress College in California has a Geographic Information Systems/Marketing certificate program offered between the departments of Computer and Information Systems (CIS) and Geography.

> *This certificate program (offered jointly with the Geography Department) provides students with the knowledge and skills to use Geographic Information Systems (GIS) computerized mapping techniques in the field of marketing. Converting geographic data into visual displays, GIS shows businesses where potential customers are and enables them to evaluate sites, plan distribution networks, organize sales territories, and find new business opportunities. 15 Units*(Cypress College, 2005)

OTHER NOTES

Because of precedents at other institutions, classes in the Marketing program are excellent candidates for inclusion as electives *in* the GIS program. It is a great way to provide students in GIS technology a broad exposure to and an understanding of a field/area with rich spatially-associated data. It will also increase their appeal to businesses and organizations who will appreciate the student's/participant's technical and business background and knowledge. This could possibly qualify the student/participant for management-related positions within their organization.

Mathematics

SDMC DEPARTMENT

Mathematics

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

2

SDMC DEPARTMENT DESCRIPTION

Successful completion of this curriculum will develop
competence in mathematics through differential and
integral calculus, providing an adequate background for
employment in many technological and scientific areas
as well as providing a firm foundation for students
planning advanced study.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

In mathematics, there are two primary GIS applications areas. Each is
distinct.

GIS analysis is the first application area. Math is a chief element of GIS
analysis.(Scholz, 2001) A major subset of mathematics is statistics. GIS
analysis involves the use of spatial statistics which is a specialized subset
of statistics.

As GIS utilization increases, it is increasingly being applied as a highly
specialized analytical tool and decision support system. "Today there are
many companies that hire people that have a grounding in mathematics
and statistics for a GIS position."(Scholz, 2001)

The second application area is computer programming. "[It appears that]
there is a larger demand by those developing GIS software and
applications that require a strong knowledge of mathematics in order to
develop products that the GIS user community needs."(Scholz, 2001)
From this standpoint, the argument for GIS curricula inclusion is similar to
the argument made for the Computer Information Sciences program.

(see Computer Information Sciences)

MATHEMATICS

A student/participant in the mathematics program may benefit by having exposure to GIS by being able to open up opportunities for career advancement and vocational specializations.

CITED UTILIZATION IN ORGANZATION(S)

Mathematicians Working with GIS

GIS In Limited is a software development company that has a team of computer scientists, mathematicians, programmers, and engineers to support the Information Systems (IS) industry.(GIS In, 2005)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

Courses in GIS Applications for Business for Math and Computer Science Students

Fort Hays State University includes GIS curricula in a business specialization track for students/participants in their mathematics and computer science program.(Fort Hays State University, 2005)

GIS Touted as a Useful Training and research Tool for Math

The University of Wyoming's math department touts GIS as a useful teaching and research tool.

> *From a research standpoint, GIS can be used to produce better real-world information for construction and validation of numerical models. Mathematical concepts also appear prominently in the theoretical aspects of GIS. The spatial visualization capabilities, the use of spatial data sets and real-life examples are some of the possible contributions of GIS to our instruction.*(University of Wyoming, December 1998)

OTHER NOTES

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Multimedia

SDMC DEPARTMENT

Multimedia

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

3

SDMC DEPARTMENT DESCRIPTION

This program is designed to provide students of
multimedia the opportunity to develop necessary
foundation skills, master the tools and processes, and
undergo industry standards production experiences. The
program provides students with a comprehensive
approach to the field of multimedia. The program
curriculum is structured so as to provide students with
a balance between aesthetic and practical design
application. Upon completion of this program, students
will be qualified for entry-level employment in the
multimedia industry.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

Multimedia and GIS have been long touted as complementary areas of
study in computing. It enhances existing visualization capabilities and
reinforces interest in the technology.(Hu, 2004)

 [Multimedia representations] *offer richer concepts than two-dimensional
GIS as they extend the dimensionality, the data types, the analytical
powers and the information management capabilities of the existing
system.*(Bill et al., 2000).

With the widespread use of Web-based GIS, multimedia components are
already being integrated. Some of the multimedia components include
HTML and hyperlinks, Macromedia Flash, Web graphics, streaming
digital video, etc.

Car navigation systems using GIS and GPS technology are excellent
examples of combining multimedia with GIS. Consumer-grade car

navigations systems use interactive graphics, verbal prompts, and animation to provide directions or indicate position to a user.

With the growth of multimedia and GIS technology and utilization, it is very plausible that, in the near future, multimedia implementations of GIS will be the norm. With GIS curricula, a student/participant in the Multimedia program will gain valuable insights and experiences with an additional technological tool that they may work with to address their current and future project needs. They will also be able to log GIS knowledge and skills in their skills portfolio to secure future employment/advancements/commissions.

CITED UTILIZATION IN ORGANZATION(S)

Multimedia GIS Still Photos and Video Footage

Emerging multimedia GIS technologies by Red Hen Systems are described in an article by Joseph Berry in Fort Collins, Colorado. Some examples described in the article include video and still cameras which record geographic positions from a GPS receiver onto film.(Berry, 2000) This action "georeferences" the still photos and video footage to create a true sense of place. The photos or footage can then be "linked" through multimedia technology and GIS maps, since the positions are known.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

Multimedia GIS Workshop for Students

The Department of Geography/Geology at the University of Nebraska at Omaha has conducted a workshop that covers a broad range of multimedia technology. Their workshop provides an overview of multimedia techniques, the web, and applications in GIS and mapping.(Peterson, [date unknown])

Merge Multimedia and GIS for Information Systems

This following is a brief description from a study which touts the benefits of merging multimedia technology and concepts with GIS for a business or tourist information system:

MULTIMEDIA

The integration of internet-technology and multimedia-elements into GIS-applications is a very promising way of improving the possibilities for constructive communication between ordinary citizens, politicians, and planning experts. Furthermore it is a chance for using once created (relatively expensive) planning data for multiple purposes, for example as the basis of business or tourist information systems.(Ferschin and Schrenk, 1998)

OTHER NOTES

Classes in the Multimedia program are excellent candidates for inclusion as electives in the GIS program. As GIS technology and applications become more mainstream in daily life (e.g. Google Earth, MapQuest, GPS navigation), research, and education; more is expected from the technology. Examples range from Internet mapping to 3-D virtual reality animation. Multimedia classes can offer a student/participant in GIS additional skills and knowledge that may assist them with creating custom implementations of GIS technology.

Physical Sciences

SDMC DEPARTMENT

Physical Sciences

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

4

SDMC DEPARTMENT DESCRIPTION

Offers the Associate in Science Degree in Physical
Sciences with a designated major in Chemistry,
Engineering, Physical Sciences (General), or Physics.
The degree will be granted upon completion of a
required pattern of specialization and other degree
graduation requirements. A certificate program is also
offered in Chemistry, Engineering, Physical Science
(General), or Physics consisting of a required pattern of
major courses. This permits the student to fulfill the
lower division requirements for transfer programs to
four-year colleges as well as to acquire the necessary
skills for employment as a technician.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

GIS is a very useful tool to support the physical sciences. The
Engineering and Physical Sciences (General) majors within the Physical
Sciences program are particularly well-suited for GIS curricula inclusion
because of the emphasis on spatial data.

In the physical sciences, GIS technology and applications can be used as a
tool to aid in research or as a decision support system. Both applications
document, analyze, and visualize spatially-related data.

A good example of GIS used as a physical sciences research tool is the
mapping of earthquake faults (lineaments) and recorded earthquakes to
predict future earthquakes or assess the risk/probabilities of earthquakes
for existing structures and populations.

Another application is using a customized GIS system as a real-time stream flow monitoring system to support urban flooding warning systems and other decision support systems.

GIS and other closely-related geospatial areas, such as remote sensing, have an extensive history of use in such physical science sub-fields as earth sciences and geology. Specific application areas include lineament and mineral mapping, exploration, meteorology, and conservation science. The common theme among these applications is <u>location-based information.</u>

Engineers, particularly landscape and civil engineers, use GIS to support site and construction planning. Again, location-based information is the unifying theme.

CITED UTILIZATION IN ORGANZATION(S)

GIS Utilization in Climate Change Studies

Earth resource/conservation scientists are using GIS tools and related technology to study the effects of climate change in the Arctic by tracking fast-moving glaciers.(Canfield, 2005)

Abundance of "GIS-Ready" Data for the Physical Scientists

There are extensive public datasets and imagery available for climate scientists and meteorologists. Much of this data are readily available as "GIS-ready" data. That is, they require little or no preprocessing before they can be visualized and analyzed in a GIS.(Shipley et al., 2000)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS is a Tool for Civil Engineers

A significant argument for inclusion of GIS in civil engineering programs is made in the detailed description of GIS applications in civil engineering at the University of Hawaii. Here is a short clip of the supporting argument:

> *The infrastructural systems that civil engineers plan, design and operate, as well as the human activities they support, have a strong*

geographical (that is, <u>spatial</u>) orientation. Consequently, civil engineers have always used ways to represent their work in spatial terms. Indeed, accurate maps, plans and drawings are at the heart of good civil engineering practice.

In the past, these spatial representations and their associated attribute descriptions were produced on what we now call "hardcopy" media that are very inflexible and awkward to revise, manipulate and combine. Relatively recent developments in computer hardware and software technology, however, are relegating these old methods to a limited set roles for which they are best suited. Civil engineers were among the first to adopt the new technology for computer-based analysis, design and visualization.

Geographic Information Systems

*Geographic information systems represent a quantum leap from earlier computer-aided mapping and design in at least two respects. First, they deal with "intelligent maps." For example, they not only "know" that a line of a particular color and thickness exists at some location on a map, but they also "know" that this line represents, say, a highway segment in a **real world** location and that this highway is classified as a freeway, has four lanes in each direction etc. The second contribution of GIS is the ability to perform overlays and spatial analysis, to be able, for example, to tell that the highway crosses a wetland area that is the habitat of a particular endangered species etc. In all fairness, I should say that a lot of natural cross-fertilization has happened between CAD and GIS to the point that the distinction between them is almost impossible to draw.*(Papacostas, C. S., 1995)

OTHER NOTES

Because of precedents at other institutions, classes in the Physical Sciences program are an excellent candidate for inclusion as an elective *in* the GIS program. It is a great way to provide students in GIS technology a broad exposure to and an understanding of a field/area with rich spatially-associated data.

Psychology

SDMC DEPARTMENT

Psychology

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

2

SDMC DEPARTMENT DESCRIPTION

A program suited to the needs of both the two year
student and the transfer student who plan to major or
minor in Psychology or related fields. It will provide the
student with greater understanding of behavior. Upper
division and graduate studies can lead to vocations in
teaching, research, counseling, and other areas. An
upper division minor in Psychology may be an
important asset to majors in other fields.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

GIS is primarily viewed as a research tool to aid in social psychology,
criminal psychology, and experimental psychology investigations that
have some kind of spatial component, factor, or variable. Some spatial
considerations in a psychological investigation may be living areas;
proximity to objects, businesses, etc.; and the daily workplace commute.

Other applications of psychology include models of spatial
cognition.(Gopal, 1997)   This is the study of how the brain abstracts a
physical and virtual sense of space and location. This kind of research
could be used to improve spatial data models used in GIS programs.

Many of the same arguments for GIS utilization as a research tool for
student/participants in the Psychology program are the same for the Social
Sciences program.

(see Social Sciences)

CITED UTILIZATION IN ORGANZATION(S)

GIS Electives for Criminal Justice Programs

Criminal justice programs have a strong relationship to social and criminal psychology programs and have several related curricula. The criminal justice and forensic science programs at Radford University allow their students to choose elective courses in introductory GIS.(Radford University, 2005)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS Usage in a Psychological Study

An environmental psychology study by Tanika Kelay at the Department of Psychology at the University of Surrey utilizes GIS technology to aid in her analysis of the public perception of air pollution versus empirically documented air pollution within a location.(Kelay, 2002) This is an excellent example of using GIS as a research tool.

OTHER NOTES

*

Real Estate

SDMC DEPARTMENT

Real Estate

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

4

SDMC DEPARTMENT DESCRIPTION

The Real Estate Program offers students the following options: a Certificate of Completion for Real Estate Salesperson or Real Estate Appraisal; a Certificate of Achievement for Real Estate Broker; and an Associate in Science degree in Real Estate.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

Real estate, by definition, refers to some kind of location; and is presently a major application area of GIS and related spatial technologies. There are two significant applications of GIS in real estate. They include real estate decision support systems and GIS Web-mapping applications.

Real estate decision support systems are a Geographic Information System with a database of land use data, cadastral data (assessor's data), buildings, their associated locations, and other data. It is generally a commercial tool for business analysts and important strategic decision makers in industry. It can also be seen as a marketing tool and a general tool to aid in business intelligence. Information can be managed, organized, queried, and visualized in ways that were not possible with traditional information management systems.(Peterson, 1998)

A real estate decision support system can conceivably aid in site or building selection based on such criteria such as "corner lot," "two-story," "greater than 0.5 acre lot," "west-facing entrance," "price under $600,000," "age of property is less than 10 years," "located within 10,000 feet of greatest concentration of a certain demographic," "has favorable tax laws," etc. Other advanced variables could include "predominant soil type of land that property is on is…," "minimize distance to local businesses and all suppliers," etc. In other words, a real estate decision support system could not only help residential real estate buyers, it can also support large businesses like real estate investment companies, sales

and distribution companies, supply chain companies, building construction companies, etc. by maximizing profitability, minimizing cost, etc. with optimal site selection.

GIS Web-mapping applications for real estate are closely related to the real estate decision support systems just discussed. They offer more limited functionality than a standalone real estate decision support system and are designed for advertising land and properties. Their most significant feature is their ability to be accessed over the Web. This has caused great pains for the Realtor industry since similar tools for searching for real estate were once only available to them. Now "Multiple Listing Services" are accessible to the public over the Web.(Flat Fee Listing, 2005) Many of these Web-based Multiple Listing Services (MLS) employ basic GIS technology by mapping the property/land and displaying its location on a Web-based map (geocoding).

Additionally, several "sell-it-yourself" or "sell-it-*nearly*-yourself" real estate sales companies are appearing and are eating into the long term need and income of a large number of full-service real estate agents. Examples include "Help-U-Sell"(Help-U-Sell, 2005) and "Flat Fee Listing."(Flat Fee Listing, 2005) They list land and property on the Web-based Multiple Listing Services and offer some services to sellers including legal documentation assistance. This is not a bad thing for the consumer because it enables them to have more options at a significantly lower cost. It does not appear to be a negative trend for the real estate agents who are embracing the technology instead of shunning it.

Several complementary occupations including appraisers, title companies, assessors, real estate investment trust managers, and real estate software designers also utilize GIS technology to aid in their roles and decision making.

Because of the evolution of this real estate GIS tools, it would be highly valuable for a student/participant in the Real Estate program to have GIS curricula in their course work. Real Estate offices, companies, and various organizations need employees who understand GIS and who can work with the technology. In many cases, these companies are hiring GIS consultants to assist them in their computing needs.

CITED UTILIZATION IN ORGANZATION(S)

GIS for Real Estate Decision Support

The Journal of Housing Research describes how spatial decision support systems can be used for residential real estate and support businesses and organizations.(Peterson, 1998)

Real Estate is a Major Application Area of GIS

A showcase of case studies of GIS and real estate are presented by the publisher of the world's most popular GIS software:

> *Like real estate, GIS is all about "location, location, location." ESRI offers a variety of GIS–based solutions designed for all segments of the real estate business such as map–based content management and sophisticated investment analysis.*
>
> *GIS allows you to integrate a wide variety of data into one, common format—a map. Presenting your customers with a visual representation of all the information affecting the desirability and value of a property can give a far more accurate picture of a property's suitability to their needs.*(ESRI, 2005)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

Real Estate Emphasis in a GIS Program

Due to the utility of GIS to support Real Estate, Foothill College's GIS program includes Real Estate as a "focus area" in which GIS technology can be directly applied in a student's/participant's program. Besides further emphasizing the cross-disciplinary nature of GIS, the school is advantageously cross-feeding students in a broader more enriching program of study.(Foothill College, 2005)

OTHER NOTES

Because of precedents at other institutions, classes in the Real Estate program are an excellent candidate for inclusion as an elective *in* the GIS program. It is a great way to provide students in GIS technology a broad

exposure to and an understanding of a field/area with rich spatially-associated data. GIS professionals and programmers are in increasing demand at national-level real estate organizations and at real estate service organizations that assist local real estate companies. Because spatial data is strongly represented in the real estate field, it may benefit students in the GIS program to gain some real estate business domain knowledge to assist them in understanding and fulfilling the needs of the industry.

Selected Studies

SDMC DEPARTMENT

Selected Studies

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

1

SDMC DEPARTMENT DESCRIPTION

Designed for students who are interested in a program
of studies that will allow them to attain educational or
career goals that are not satisfied by associate degrees
offered in Degree Curricula and Certificate Programs
listed in this catalog.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

GIS knowledge and technology is an interdisciplinary tool that can aid in
research, decision making, supporting research, and presenting analyses.

The benefits of having GIS curricula to students/participants in the
Selected Studies program will depend on their specific
educational/vocational goals.

The arguments for GIS curricula inclusion in the Selected Studies program
are similar to the ones made in the Liberal Arts program and the Physical
Sciences program. Again, applicability will depend on a
student's/participant's specific vocational goal.

Will they need domain knowledge and skills with this tool and will it help
them in their current and future occupations?

Flexibility and exposure to many different areas/fields seem to be part of
the goals of this program.

(see Liberal Arts)

(see Physical Sciences)

CITED UTILIZATION IN ORGANZATION(S)

(see Liberal Arts)

(see Physical Sciences)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

(see Liberal Arts)

(see Physical Sciences)

OTHER NOTES

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Social Sciences

SDMC DEPARTMENT

Social Sciences

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

5

SDMC DEPARTMENT DESCRIPTION

The general Social Sciences major is designed to provide
the student with an introduction to the varied
disciplines of the Social Sciences and Humanities.
Students who intend to transfer to a four-year college
or university are urged to plan their programs carefully
in conjunction with the requirements of the target
school. The general Social Sciences major is also an
excellent choice for the undecided student who simply
wants to complete lower-division General Education
requirements with a solid Liberal Arts preparation. More
specific Social Sciences and Humanities concentrations
are provided in Geography, History, Philosophy, and
Political Science majors.
It is easy to make the transition from the general Social
Sciences major to one of the specific concentrations if
the decision is made early in the student's academic
career. The Social Sciences majors (general and
specific) prepare the student for upper-division work in
the various Social Sciences disciplines leading to
advanced degrees and/or careers in public
administration, business, teaching, research, etc.(San Diego Mesa College,
2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

Social Sciences are a major application area of GIS and complementary
spatial knowledge & technologies. In the various fields/areas of social
science, GIS is generally used as a research and analysis tool assisting
investigators, strategic decision makers, and analysts.

The primary benefit a student/participant in the social sciences will realize by including GIS and general spatial knowledge in their program is general competency with powerful tools to support analysis, presentation, and visualization of data primarily related to research applications within the various fields/areas.

Obviously, being able to abstract, represent, visualize, and analyze data based on location represents a very powerful tool for the field. Powerful arguments and effective presentations of data can be made with GIS. Data presentation and analysis are significantly enhanced by using GIS tools to exploit spatial and temporal dimensions of the data/observations. Combined with associated reports, presentations, and/or publications, the student/participant will be able to provide much stronger documentary evidence supporting their positions/arguments. In this sense, GIS skills and knowledge can be thought of as an enhanced research and presentation tool. This application of GIS will support academics, field-based researchers, and researchers in organizations.

GIS technology is seen as a greatly suitable to interdisciplinary social sciences research and many organizations advocate its utilization.

The [Center for Spatially Integrated Social Sciences] (CSISS) recognizes the growing significance of space, spatiality, location, and place in social science research. It seeks to develop unrestricted access to tools and perspectives that will advance the spatial analytic capabilities of researchers throughout the social sciences. CSISS is funded by the National Science Foundation under its program of support for infrastructure in the social and behavioral sciences.

GIS databases [offer a] *new way of organizing social science data and recently developed spatial analysis tools and modeling methods as a way to integrate work by the social science disciplines. Analysis of the myriad of topics related to human and social dynamics covered by social science research and teaching have in common that these take place in a spatial setting and draw heavily on spatially organized information resources.*(CSISS, 2005)

Again, it can't be overemphasized how useful GIS is for social sciences research. The trend is so strong and the opportunities are so great that many institutions are now building new programs to address GIS utilization in the social sciences. One such initiative is a proposed Ph.D. program at the University of Toledo entitled Spatially-Integrated Social Science. The significance of this program is that it is collaboration between several different departments at the university: Geography and

Planning, Economics, Political Science & Public Administration, and Sociology & Anthropology.(University of Toledo, 2004) In light of this and many other applications of GIS in the social sciences field, GIS technology and concepts can be seen as a "glue" which can be used to unify these disciplines.

A student/participant in the Social Sciences program will certainly benefit from GIS curricula.

CITED UTILIZATION IN ORGANZATION(S)

GIS for Public Policy Decisions

There are extensive examples using GIS technology and principles to support public decision making in such applications as urban & regional planning, and public health.(Chapelet & Lefebvre, [date unknown]) GIS in this context is seen as a powerful visualization and analysis tool of current data. After the GIS data is examined, better public policy decisions can be made by civic leaders, representatives, and staff.

CITED PROGRAM(S) AT OTHER SCHOOL(S)

Social Sciences GIS Certificate Program for Government and Private Sector Decision Support

The University of Texas at Austin's social sciences department has a GIS certificate program which covers GIS technology and concepts for government and private sector applications. The program describes GIS as "rapidly becoming the backbone of many government and private sector information systems."(University of Texas, 2005)

Extensive Use of GIS in Social Sciences Curricula and Research

In addition to housing *Spatial Structures in the Social Sciences*, an institute which examines "the impacts of spatial relations and contextual effects on social science issues," Brown University also offer such classes as Social Sciences 187: Introduction to GIS: A Social Sciences Perspective.(Brown University, 2005)

OTHER NOTES

Because of precedents at other institutions, classes in the Social Sciences program are an excellent candidate for inclusion as an elective *in* the GIS program. It is a great way to provide students in GIS technology a broad exposure to and an understanding of a field/area with rich spatially-associated data.

Sociology

SDMC DEPARTMENT

Sociology

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

3

SDMC DEPARTMENT DESCRIPTION

A program suited to the needs of both the two-year
student and the transfer student who wished to major
or minor in sociology or related fields. It is designed to
provide the student with a greater understanding of
human interactions, social processes, and social
structures.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

GIS knowledge and technology is an interdisciplinary tool that can aid in
research, decision making, supporting research, and presenting analyses.

A student/participant in the Sociology program will most benefit from
GIS's suitability as an interdisciplinary research and analysis tool. Most
of the strongest arguments in this application area are duplicated in the
section covering the Social Sciences program.

(see Social Sciences)

CITED UTILIZATION IN ORGANZATION(S)

(see Social Sciences)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

GIS for Sociology Research

Several examples of GIS utilization in sociology research are given at Penn State's Population Research Institute's Web site.(Penn State [2], 2005)

Sociology Emphasis in a GIS Program

Due to the utility of GIS to support sociology, Foothill College's GIS program includes sociology as a "focus area" in which GIS technology can be directly applied in a student's/participant's program. Besides further emphasizing the cross-disciplinary nature of GIS, the school is advantageously cross-feeding students in a broader more enriching program of study.(Foothill College, 2005)

(see Social Sciences)

OTHER NOTES

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Travel and Tourism

SDMC DEPARTMENT

Travel and Tourism

GIS APPLICABILITY SCALE (1=slightly applicable, 5=strongly applicable)

2

SDMC DEPARTMENT DESCRIPTION

Prepares students for entry level employment with
airlines, travel agencies, tour companies, convention
organizations, visitor attractions, recreational and
leisure services, and related occupations.
Careers include travel agent, airline ticket agent,
reservation sales agent, passenger service
representative, visitor host/hostess, tour guide, and
convention coordinator. Work experience is available
with approval of the instructor.(San Diego Mesa College, 2005)

RECCOMENDATIONS/JUSTIFICATIONS FOR GIS INCLUSION

The main applications of GIS in the travel and tourism field/area are
associated with tourism business analysis. This includes economic impact,
marketing, behavior, and infrastructure analyses by public and private
sector groups.

The "Travel and Tourism-GIS" special interest discussion group on Yahoo
Groups has a good description of the specific GIS application areas in this
area/field:

*In the travel and tourism industry, finding the best location for a
travel-related business, analysis of tourism landmarks and their
relationship to transportation, and market research to determine
travel and tourism customers can be facilitated by geographic
information systems. This special interest group will discuss uses
of GIS on the desktop and on the web by airlines, hotels, rental car
and auto club agencies, train companies, cruise companies, tour
operators, travel agencies, and promoters of destinations.*(Yahoo
Groups, 2005)

In this context, GIS is seen as a strong marketing intelligence and analysis tool. Many of the arguments made for GIS curricula inclusion in the Marketing program also apply.

(see Marketing)

The utility of GIS knowledge and skills to a current student/participant in the Travel and Tourism program may not be immediately apparent until such time they enter a management/director/marketing manager role with a travel and tourism-affiliated organization of business. This knowledge and skill set may also present opportunities for further study and growth in the travel and tourism/hospitality fields.

CITED UTILIZATION IN ORGANZATION(S)

GIS as an Analysis Tool for the Hospitality Industry

GIS is seen a great tool to support analysis and reporting of hospitality industry marketing and business.(Tennessee State University, 2002)

(see Marketing)

CITED PROGRAM(S) AT OTHER SCHOOL(S)

Travel & Tourism Emphasis in a GIS Program

Due to the utility of GIS to support Travel & Tourism, Foothill College's GIS program includes Travel & Tourism as a "focus area" in which GIS technology can be directly applied in a student's/participant's program. Besides further emphasizing the cross-disciplinary nature of GIS, the school is advantageously cross-feeding students in a broader more enriching program of study.(Foothill College, 2005)

(see Marketing)

OTHER NOTES

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References

REFERENCES

Attention: An online link to this reference page is available to facilitate your research and to enable you to click URL references without having to re-type them. This list of references (only) is available at http://geoinfo.sdsu.edu/hightech/Sources.

ArcUser. April 1999. "*GIS for Health Care Today and Tomorrow.*"
http://www.esri.com/news/arcuser/0499/umbrella.html [URL accessed 8/5/2005].
ArcUser. ESRI. Redlands, California, USA.

ArcUser. 2000. "*Learning with GIS.*"
http://www.esri.com/news/arcuser/0700/umbrella11.html [URL accessed 8/5/2005].
ArcUser. ESRI. Redlands, California, USA.

Berry, Joseph K. 2000. "*Capture Where and When on Video-Based GIS.*"
http://www.geoplace.com/gw/2000/0009/0900bm.asp [URL accessed 8/11/2005].
Berry & Associates, Consultants in GIS Technology. Fort Collins, Colorado, USA.

Bill, R., Dransch, D. & Voight, C. 1999. "*Multimedia GIS: Concepts, Cognitive Aspects and Applications in an Urban Environment.*" *Spatial Multimedia and Virtual Reality.* Taylor and Francis. London, England, United Kingdom.

Blue Sky Development. June 2005. "*Transitional GIS.*"
http://www.blueskydev.com/transitional_gis.htm [URL accessed 8/1/2005]. Blue Sky Development. Sugar Land, Texas, USA.

Brown University. 2005. "*Initiative in Spatial Structures in the Social Sciences.*"
http://www.s4.brown.edu/ [URL accessed 8/15/2005]. Spatial Structures in the Social Sciences. Brown University. Providence, Rhode Island, USA.

Canfield, Clarke. 2005. "*Scientists tracking fast-moving glaciers.*"
http://www.seacoastonline.com/news/08012005/maine/55595.htm [URL accessed 8/12/2005]. [Associated Press]. *Portsmouth Herald Maine News.* Portsmouth, Maine, USA.

CannyLink. 2005. "*Architecture Firms.*"
http://www.cannylink.com/architecturefirms.htm [URL accessed 8/5/2005]. Canny Link. Coral Springs, Florida, USA.

Centers for Disease Control (CDC). 2005. "*Demographic Group Options: GIS Reproductive Health Atlas.*"
http://www.cdc.gov/reproductivehealth/GISAtlas/Demographics.htm [URL accessed 8/2/2005]. Centers for Disease Control and Prevention. Division of Reproductive Health. Atlanta, Georgia, USA

REFERENCES

Centers for Disease Control (CDC). 2005. "*Division of Public Health Surveillance and Informatics: Public Health and GIS Overviews.*" http://www.cdc.gov/epiinfo/maps.htm#overviews [URL accessed 8/1/2005]. Centers for Disease Control and Prevention. Epidemiology Program Office, Division of Public Health Surveillance and Informatics, Atlanta, Georgia, USA

Centre College. 2002. "*Anthropology 360: GIS and the Environment.*" http://web.centre.edu/regist/catalogarchive/01-02catalog/antcc.html [URL accessed 8/1/2005]. Centre College Course Offerings. Centre College. Danville, Kentucky, USA.

Chapelet, Pierre & Lefebvre, Bertrand. [date unknown]. "*Contextualizing the Urban Health Care System.*" http://www.csh-delhi.com/v2/publications/electronicop11/OP/intro.htm [URL accessed 8/15/2005]. Centre de Sciences Humaines. New Delhi, India.

City of Des Moines. 2005. "*City of Des Moines IT Department – GIS.*" http://www.ci.des-moines.ia.us/departments/IT/GIS.htm [URL accessed 8/5/2005]. The City of Des Moines. Des Moines, Iowa, USA.

Clark Nexsen. 2005. "*Clark Nexsen – Award Winning Architecture and Engineering Design Firm.*" http://www.clarknexsen.com [URL accessed 8/1/2005]. Clark Nexsen Architecture, Engineering, Interior Design. Norfolk, Virginia, USA.

Craglia, Massimo & Maheswaran, Ravi. July 2004. *GIS in Public Health Practice: Opportunities and Pitfalls*. CRC Press. Boca Raton, Florida, USA.

Consultancy within Engineering, Environmental Science and Economics (COWI). 2005. "*Construction Technique and Building Physics.*" http://www.cowi.com/cowi/en/topmenu/aboutcowi/factsandfiguresthequickversion/profilecompetencies/engineering/constructiontechniqueandbuildingphysics/ [URL accessed 8/2/2005]. Consultancy within Engineering, Environmental Science and Economics. San Francisco, California, USA.

CSISS. 2005. "*Center for Spatially Integrated Social Science.*" http://www.csiss.org/ [URL accessed 8/15/2005]. The Regents of the University of California. University of California at Santa Barbara. Santa Barbara, California, USA.

Cypress College. 2005. "*Management and Marketing: Geographic Information Systems/Marketing Certificate.*" http://business.cypresscollege.edu/~management/programs.shtml [URL accessed 8/10/2005]. Department of Business. Management Program. Cypress College. Cypress, California, USA.

Design Presentation. 2005. "*Design Presentation & Services, Logo Vectorization, Graphic Design, Typing & Data Entry, Data Processing, Digitization, Raster-to-Vector,*

REFERENCES

Desktop Publishing." http://www.designpresentation.com/services.htm [URL accessed 8/1/2005]. Design Presentation. New York, New York, USA

Endelman, David. 1999. "*The Fine Art of GIS Cartography*." http://gis.esri.com/library/userconf/proc99/proceed/papers/pap413/p413.htm [URL accessed 8/1/2005]. Proceedings of the 1999 ESRI Users Conference. Geomatic Arts. Camarillo, California, USA.

Ervin, Stephen M. (date unknown). "*Designing with Maps: Integrating GIS and CAD*." Department of Landscape Architecture, Graduate School of Design, Harvard University. Cambridge, Massachusetts, USA.

ESRI. 2005. "*GIS for Real Estate*." http://www.esri.com/industries/real_estate/ [URL accessed 8/12/2005]. ESRI. Redlands, California, USA.

ESRI[2]. 2005. Plenary Session. (Jack Dangermond.) *2005 ESRI Users Conference*. ESRI. San Diego, California, USA.

Ferschin, Peter and Schrenk, Manfred. 1998. "*Integration of GIS, Hypertext and Multimedia-Elements for Spatial Planning Purposes*." http://www.geogr.muni.cz/lgc/gis98/proceed/shrenk.htm [URL accessed 8/11/2005]. Department for Computer-Aided Planning and Architecture. Vienna University of Technology. Vienna, Austria.

Flat Fee Listing. 2005. "*Flat Fee Listing*." http://flatfeelisting.com/ [URL accessed 8/15/2005].

Foothill College. 2005. *"Certificate in Geographic Information Systems at Foothill College."* http://www.foothill.fhda.edu/fac/klenkeit/gis/certificate/index.htm [URL accessed 8/5/2005]. Foothill College. Los Altos Hills, California, USA.

Fort Hays State University. 2005. "*Mathematics and Computer Science Undergraduate Program*." http://www.fhsu.edu/macs/degreeprograms/degrprghome.shtml [URL accessed 8/10/2005]. Fort Hays State University. Hays, Kansas, USA.

Garcia, Victor. 2001. "*Bringing Anthropology Home: Latina/o Students, Ethnographic Research, and U.S. Rural Communities*." The Julian Samora Research Institute. Michigan State University. East Lansing, Michigan. USA.

George Mason University. 2005. "*George Mason University: Civil, Environmental and Infrastructure Engineering*." http://www.civil.gmu.edu/about_ceie.htm [URL accessed 8/2/2005]. Civil, Environmental and Infrastructure Engineering. George Mason University. Fairfax, Virginia, USA.

REFERENCES

GIS for Business Resource Guide. 2005. "*GIS for Business Resource Guide: Online Source of GIS for Business Resources.*" http://www.cast.uark.edu/other/gisb/ [URL accessed 8/3/2005]. Center for Advanced Spatial Technology (CAST). University of Arkansas. Fayetteville, Arkansas, USA.

GIS In. 2005. "*About GIS In.*" http://www.gisin-bg.com/en/display.php?page=about [URL accessed 8/10/2005]. GIS In. Bulgaria.

GIS Lounge. 2005. "*Conservation Biology and GIS .*" (Web index). http://gislounge.com/ll/conservation.shtml [URL accessed 8/1/2005]. GIS Lounge. Los Angeles, California, USA.

Gopal, Suchi. 1997. "*Unit 73: GIS and Spatial Cognition.*" http://www.geog.ubc.ca/courses/klink/gis.notes/ncgia/u73.html [URL accessed 8/12/2005]. National Center for Geographic Information & Analysis (NCGIA). Santa Barbara, California, USA

Habitat. [date unknown]. "*Computers in your Subject Area: Building Construction.*" http://cebe.cf.ac.uk/learning/habitat/HABITAT1/Subjects.html#Construction [URL accessed 8/2/2005]. Centre for Education in the Built Environment. Cardiff, Wales, United Kingdom.

Hassen, Rob. April 2003. "*Building GIS Communities Across Campus.*" http://www.esri.com/news/arcuser/0403/cmu.html [URL accessed 8/3/2005]. Marketing Research. Central Michigan University. Mount Pleasant, Michigan, USA.

Help-U-Sell. 2005. "*Help-U-Sell Real Estate.*" http://www.helpusell.com/ [URL accessed 8/15/2005].

Hensley-McGaffey, Misty. September 2004. "*Teaching with GIS in the Liberal Arts: It's Hot, It's New, Now What Do I Do?*" http://www.midwest-itc.org/index.php/web/programs/past_progams/teaching_with_gis_in_the_liberal_arts [URL accessed 8/8/2005]. Midwest Instructional technology Center (MITC). Ann Arbor, Michigan, USA.

Herr-Harthorn, Barbara. 2005. "*GIS and Population Science.*" http://www.csiss.org/GISPopSci/about/personnel.php#bhh [URL accessed 8/3/2005]. Center for Spatially Integrated Social Science. University of California. Santa Barbara, California, USA.

Hu, Shunfu. 2004. "*Web-Based Multimedia GIS for the Analysis and Visualization of Spatial Environmental Database.*" http://www.isprs.org/commission4/proceedings/pdfpapers/449.pdf [URL accessed 8/11/2005]. *Technical Commission IV Proceedings*. The International Society for Photogrammetry and Remote Sensing. Ahmedabad, India.

REFERENCES

Iowa State University College of Design. 2005. *"Interior Design."*
http://www.design.iastate.edu/FILES/id.pdf [URL accessed 8/6/2005]. College of Design.
Iowa State University. Ames, Iowa, USA.

ISeek. 2005. *"Career: Interior Designers."*
http://www.iseek.org/sv/13000.jsp?id=100109 [URL accessed 8/6/2005]. ISeek.
Business Technologies. Temple Terrace, Florida, USA.

Kay, David. [date unknown]. *"What is GIS and What Does it Do?."*
http://www.cdtoolbox.org/community_benchmarking/000178.html [URL accessed
8/8/2005].   Community & Economic Development. Cornell Local Government Program.
Cornell University. Ithaca, New York, USA.

Kelay, Tanika. 2002. *"Integrating Scientific and Lay Accounts of Air Pollution."*
http://www.surrey.ac.uk/~pss1su/epuk/edra32abstracts.html [URL accessed 8/12/2005].
Department of Psychology. University of Surrey. Surrey, England, United Kingdom.

Landscape Information Hub. 2005. *"LIH Landscape Information Hub: GIS."*
http://www.lih.gre.ac.uk/compute/gis.htm [URL accessed 8/1/2005]. Landscape
Information Hub. University of Greenwich Schools of Architecture. Greenwich,
England, United Kingdom.

Langford, Barry E. 2002. *"An eMarketing Concentration in the Marketing Major."*
http://www.abe.villanova.edu/proc2002/langford.pdf [URL accessed 8/8/2005]. Florida
Gulf Coast University. Fort Myers, Florida, USA.

Lexington Community College. 2005. *"The Certificate in Geographic Information
Systems Technology at Lexington Community College."*
http://www.bluegrass.kctcs.edu/LCC/GEO/GISCertificateAnnounced.htm [URL accessed
8/5/2005]. Lexington Community College. Lexington, Kentucky, USA.

Loiselle, Bette. 2002. *"Biology 483: Applications of Geographic Information Systems
(GIS) Syllabus."* http://www.umsl.edu/~loiselle/GIS2002/GIS.html [URL accessed
8/3/2005]. Department of Biology. University of Missouri at St. Louis. St. Louis,
Missouri, USA.

Los Angeles Trade Tech College. 2005. *"LATTC Educational Master Plan:
Construction Technologies, Architecture/Architectural Technology."*
http://www.lattc.edu/lattc/edmasterplan/constructiontechnologies_architecture.htm [URL
accessed 8/1/2005]. Los Angeles Community College District. Los Angeles, California,
USA.

Marble, Duane F. 1999. *"Hawaii International Conference of System Sciences:
Modeling Technologies: GIS and Decision Support."*
http://www.hicss.hawaii.edu/hicss_32/mtiscfp.htm#2 [URL accessed 8/3/2005].
Department of Geography. Ohio State University. Columbus, Ohio, USA.

REFERENCES

Matthews, Stephen A. October 2002. "*Anthropology, Archaeology and GIS.*"
http://www.pop.psu.edu/gia-core/pdfs/gis_rd_02-32.pdf [URL accessed 8/1/2005]. Penn
State Department of Anthropology. Pennsylvania State University. University Park,
Pennsylvania, USA.

Matthews, Stephen A. October 2003. "*GIS and Spatial Demography.*"
http://www.pop.psu.edu/gia-core/pdfs/gis_rd_03-63.pdf [URL accessed 8/2/2005]. Penn
State Department of Anthropology. Pennsylvania State University. University Park,
Pennsylvania, USA.

Mount Sinai School of Medicine. 2005. "*Center for Medical Informatics.*"
http://www.mssm.edu/medicine/medical-informatics/links_us.shtml [URL accessed
8/5/2005]. The Center for Medical Informatics. The Samuel Bronfman Department of
Medicine. Mount Sinai School of Medicine. New York, New York, USA.

National Research Council (USA). 2005. "*Learning to Think Spatially: GIS as a
Support System in the K-12 Curriculum.*" National Academies Press. Washington, D.C.,
USA.

North Carolina Department of Agriculture and Consumer Services. 2003. "*North
Carolina Animal Health GIS.*"
http://gis.esri.com/library/userconf/proc03/abstracts/a1124.pdf [URL accessed 8/1/2005].
North Carolina Department of Agriculture and Consumer Services, Raleigh, North
Carolina, USA.

Notre Dame University. 2005. "*African American Studies: Maps and GIS.*"
http://www.library.nd.edu/ddw/public/resource_list.cgi?term_id_1=5545&term_id_2=17
617&list_type=combo_term [URL accessed 8/2/2005]. University Libraries of Notre
Dame. Notre Dame University. Notre Dame, Indiana, USA.

NSF-ATE DUE #0401990. 2005. "*A Scalable Skills Certification Program in
Geographic Information Systems (GIS).*" National Science Foundation, Advanced
Technological Education, Division of Undergraduate Education Grant #0401990.
Washington, D.C., USA.

Papacostas, C. S. 1995. "*GIS Applications in Civil Engineering.*"
http://www.eng.hawaii.edu/~csp/Mygis/mygis.html [URL accessed 8/12/2005]. College
of Engineering. Department of Civil Engineering. University of Hawaii. Honolulu,
Hawaii, USA.

Pace, R. Kelley; Barry, Ronald; Gilley, O.W. & Sirmans, C.F. April 2000. "A Method
for Spatial-Temporal Forecasting with an Application to Real Estate Prices."
International Journal of Forecasting. Volume 16, Number 2, pp. 229-246. Elsevier,
Victoria, Australia.

REFERENCES

Peng, Zhong-Ren & Tsou, Ming-Hsiang. 2003. *Internet GIS: Distributed Geographic Information Services for the Internet and Wireless Network*. John Wiley & Sons, Inc. Hoboken, New Jersey, USA.

Penn State. 2005. "*Population Research Institute: GIS Core Functions*." http://www.pop.psu.edu/gia-core/gia_functions.htm [URL accessed 8/2/2005]. Social Science Research Institute. Pennsylvania State University. University Park, Pennsylvania, USA.

Penn State [2]. 2005. "*GIS: Sociology and Rural Sociology*." http://www.pop.psu.edu/gia-core/gissociology.html [URL accessed 8/2/2005]. Penn State Population Research Institute. Pennsylvania State University. University Park, Pennsylvania, USA.

Peterson, Kim. 1998. "*Development of Spatial Decision Support Systems for Residential Real Estate*." http://www.fanniemaefoundation.org/programs/jhr/pdf/jhr_0901_peterson.pdf [URL accessed 8/12/2005]. *Journal of Housing Research*. 9:1 pp.135-156. Fannie Mae Foundation.

Peterson, Michael P. [date unknown]. "*Workshop: Multimedia, GIS, and the World Wide Web*." http://maps.unomaha.edu/Workshops/GISWEB.html [URL accessed 8/11/2005].   Department of Geography/Geology. University of Nebraska at Omaha. Omaha, Nebraska, USA.

Princeton Review. 2005. "*Career Profiles: Computer Operator/Programmer*." http://www.princetonreview.com/cte/profiles/dayInLife.asp?careerID=43 [URL accessed 8/5/2005]. Princeton Review. Princeton, New Jersey, USA.

Radford University. 2005. "*Criminal Justice-Related Course Descriptions*." http://www.radford.edu/~crju-web/noncjcourses.htm#Geography [URL accessed 8/12/2005]. Criminal Justice Program. Radford University. Radford, Virginia, USA.

San Diego Mesa College. 2005. *San Diego Mesa College 2005 Catalog: Fall 2005, Spring 2006, Summer 2006*. San Diego Mesa College, San Diego, CA, USA.

Scholz, Janet. 2001. "*Mathematics and its Use in Geographic Information Systems (GIS)*." http://www.ma.iup.edu/calendar/Spring98/Wilson_Abstract.html [URL accessed 8/10/2005]. Indiana University of Pennsylvania. Pittsburgh, Pennsylvania, USA.

SDSU Computer Science. 2005. "*SDSU Computer Science - GIS Certificate*." http://www.cs.sdsu.edu/undergrad/gis/index.html [URL accessed 8/5/2005]. San Diego State University. San Diego, California, USA.

REFERENCES

Seiner, Robert S. 2000. "*Geospatial Data Mining for Market Intelligence.*"
http://www.tdan.com/i016hy02.htm [URL accessed 8/8/2005]. The Data Administration
Newsletter (TDAN.com). Pittsburgh, Pennsylvania, USA.

Shipley, Scott T., Graffman, Ira A., Ingram, Joseph K. 2000. "*GIS Applications in
Climate and Meteorology.*"
http://gis.esri.com/library/userconf/proc00/professional/papers/PAP159/p159.htm [URL
accessed 8/12/2005]. *Proceedings of the 2000 ESRI Users Conference.* ESRI Users
Conference 2000. San Diego, California, USA.

Sietzen, Frank. June 2004. "High-Growth Jobs Initiative." *Geospatial Solutions.*
Questex Media Group, Newton, MA, USA.

St. Lawrence University. 2005. "*Biology Courses: Biology 241: Field Methods for
Environmental Scientists.*" St. Lawrence University Information Technology. St.
Lawrence University. Canton, New York, USA.

Stockholm University. 2005. "*GIS in Linguistics (GISLI).*" http://ling-
map.ling.su.se/website/ [URL accessed 8/5/2005].   Department of Linguistics.
Stockholm University. Stockholm, Sweden.

Tennessee State University. 2002. "*GIS Software Applications in Agriculture,
Public Safety, and the Hospitality Industry.*"
http://www.tnstate.edu/iager/seminar_abstracts/maddox01.htm [URL accessed
8/15/2005]. Institute of Agricultural and Environmental Research Seminar Series.
Institute of Agricultural and Environmental Research. Tennessee State University.
Nashville, Tennessee, USA.

Texas State University. 2005. "*Zeekoe Valley GIS Study.*"
http://www.txstate.edu/anthropology/cas/cas_projects.html [URL accessed 8/3/2005].
Department of Anthropology. Texas State University at San Marcos. San Marcos, Texas,
USA.

Triplett, Dana. 2005. "*GIS in a Liberal Arts Context.*"
http://gis.nitle.org/resources/articles/article_01.htm [URL accessed 8/8/2005]. GIS at
NITLE: A Geographic Information Systems Initiative. National Institute for Technology
and Liberal Education. Ann Arbor, Michigan, USA.

Union County Ohio. 2005. "*Auditor Programs.*"
http://www.co.union.oh.us/Auditor/Auditor_Programs/body_auditor_programs.html
[URL accessed 8/1/2005]. Union County Auditor. Union County, Ohio, USA.

Unity College. 2000. "*Demand for GIS Education.*"
http://www.unity.edu/sarihou/CS2883/GIShigheredu.html [URL accessed 8/15/2005].
(Directions Magazine citation). Unity College. Unity, Maine, USA.

REFERENCES

University of Central Arkansas. 2003. "*University of Central Arkansas – Management Information Systems*." http://www.uca.edu/ubulletin/03/30105.html [URL accessed 8/5/2005]. University of Central Arkansas. Conway, Arkansas, USA.

University of Florida. 2005. "*Department of Anthropology: African American Studies*." http://www.anthro.ufl.edu/job_aas_ant.html [URL accessed 8/2/2005]. Department of Anthropology. University of Florida. Gainesville, Florida, USA.

University of London. 2005. "*Short Courses in Spatial Epidemiology*." http://www.rvc.ac.uk/Courses/Postgraduate/MSc_VetEpi_PublicHealth/CPD_SpatialEpi.cfm [URL accessed 8/1/2005]. The Royal Veterinary College, University of London. London, England, United Kingdom.

University of Missouri. [date unknown]. "*GIS Personnel Issues*." http://msdisweb.missouri.edu/presentations/gismanagement/Personnel/pdf/GISPersonnel.pdf [URL accessed 8/5/2005]. Geographic Resources Center at the University of Missouri at Columbia. University of Missouri at Columbia. Columbia, Missouri, USA.

University of Missouri. 2005. "*Business 5301: Introduction to Geographic Information Systems (3)*." http://www.umsl.edu/bulletin/2004_2005/BA/BACourseDescptGrad.htm [URL accessed 8/1/2005]. University of Missouri at St. Louis College of Business. St. Louis, Missouri, USA.

University of Montana. [date unknown]. "*Business Geographic Information Systems Minor Program Proposal*." http://www.montana.edu/wwwbor/ITEM106-2707-R0300RevAtt.htm [URL accessed 8/10/2005]. College of Business. University of Montana – Billings. Billings, Montana, USA.

University of Northern Iowa. 2005. "*Department of Geography – Liberal Arts Major Programs*." http://www.uni.edu/infosys/majors/csbs/geography/index.shtml [URL accessed 8/8/2005]. Department of Geography. University of Northern Iowa. Cedar Falls, Iowa, USA.

University of Texas. 2005. "*Geographical Information Systems Certificate: Mastering GIS for Government and Private Sector Applications*." http://www.utdallas.edu/dept/socsci/gis.html [URL accessed 8/15/2005]. Department of Social Sciences. University of Texas at Dallas. Dallas, Texas, USA.

University of Toledo. 2004. *Spatially Integrated Social Sciences: A Cluster Hiring Plan for Research Active Tenure Track Faculty in the Social Sciences*." http://spatialsocialscience.utoledo.edu/Soc_Sci_Hiring_Plan_2004_2008.htm [URL accessed 8/15/2005]. College of Arts and Sciences. University of Toledo. Toledo, Ohio, USA.

REFERENCES

University of Wyoming. December 1998. "*Academic Plan for the Department of Mathematics*." http://uw-docs.uwyo.edu/theplan/Plans/AS/Math/plan-math.htm [URL accessed 8/10/2005]. Department of Mathematics. University of Wyoming. Laramie, Wyoming, USA.

University of Wyoming. 2005. "*University of Wyoming General Bulletin: Anthropology 4160: GIS in Anthropology*." http://uwadmnweb.uwyo.edu/registrar/bulletin/anth.html [URL accessed 8/6/2005]. Anthropology Department. University of Wyoming. Laramie, Wyoming, USA.

Ventura College. 2005. "*GIS Agri-Science and Biotechnology Program*." http://academic.venturacollege.edu/bthieman/giss.htm [URL accessed 8/1/2005]. Ventura College. Ventura, California, USA.

Virginia Western Community College. 2005. "*Interior Design at Virginia Western Community College.*" http://www.vw.vccs.edu/vwspand/interior%20design.html [URL accessed 8/6/2005]. Programs in Architectural/Civil Engineering Technology, Engineering Transfer, Geographical Information Systems, and Interior Design. Virginia Western Community College. Roanoke, Virginia, USA.

Western Kentucky University. 2001. "*Department of Geography and Geology: Unit Productivity Report -- Academic Year 2000-2001.*" http://www.wku.edu/geoweb/info/unit_report.htm [URL accessed 8/15/2005]. Department of Geography and Geology. Western Kentucky University. Bowling Green, Kentucky, USA.

West Virginia University. 2005. "*West Virginia University GIS Technical Center Utilization Report: 12/2003 ~ 12/2004.*" Department of Geology and Geography. Eberly College of Arts and Sciences. West Virginia University. Morgantown, West Virginia, USA.

Yahoo Groups. 2005. "*Travel-Tourism-GIS-SIG.*" http://groups.yahoo.com/group/Travel-Tourism-GIS-SIG/ [URL accessed 8/15/2005]. Yahoo! Groups. Yahoo! Inc. Sunnyvale, California, USA.

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