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EXECUTIVE SUMMARY

This report details the accomplishments of the NSF DUE ATE (0801893) funded National Geospatial Technology Center of Excellence (GeoTech) during its fourth year of operation (Sept. 1, 2011—August 31, 2012). The major successes of the fourth year of operation are based on the carefully crafted recommendations of the National Visiting Committee, under the leadership of Deidre Sullivan, PI and Director of the MATE Center.

Geospatial Technology Competency Model (GTCM) Course Development

In 2010, the Center was able to assist the Department of Labor (DOL) in helping to complete their Geospatial Technology Competency Model (GTCM). In 2011 and 2012, we have created an entire series of new GTCM-aligned Model Courses that together form the new national GTCM Model Certificate program for geospatial technology education programs. During the fourth year, the Center developed a total of 11 new GIS course outlines that will form the basis for several new initiatives in the national geospatial education system. For example, Del Mar College—host college for the GeoTech Center, is working with the ATE Convergence Center in Dallas (Ann Beheler, PI) to develop new GIS courses, funded through a DOL TAA grant. These new online courses will be used to educate an estimated 800 new GIS technicians through 2014 in Texas and Utah. The courses will be based on the GTCM model course outlines developed by the GeoTech Center, thus aligning their content with the DOL GTCM. These GTCM model course may also become the basis for a new series of Free and Open Source Software for GIS (FOSS4G) courses in a new ATE proposal in 2012.

During the development of these courses, we engaged more than 50 different GIS educators from two year colleges and four year universities in a series of collaborative curriculum development workshops in Louisville, San Diego, Denver, and Sacramento. All of the faculty participants manage existing GIS academic programs and have committed to using the resulting GTCM model courses as the basis for realigning their own college programs with the national GTCM standard. Several of the participants have already done so, using the GTCM assessment tools, to redesign their courses and curriculum. The results of this effort are well documented in the attached external evaluator’s report.

Technology Leadership

We continue to expand our promotion of alternative GIS software, such as Free and Open Source Software for GIS (FOSS4G), to better serve educators and students unable to afford expensive proprietary solutions. With proprietary commercial GIS vendor software dominating approximately 90% of US 2YC programs, the national geospatial workforce is ill-prepared for the growing shift to Open Source Software. The Center has released an Introduction to FOSS4G course online for educators to download and use under the Creative Commons license. This course has been the most popular download on our Model Course server. In addition, we have sponsored two FOSS4G workshops, one at the FOSS4G 2011 Conference in Denver (September 2011) and one at the Association of American Geographers (AAG) Conference in NYC (February 2012) that were both sold out, with 25+ attendees each. The positive response from educators and industry to FOSS4G indicates there is a large, unmet, need for curriculum material and workshops to promote this growing area of the US geospatial technology industry. The results of these workshops and course are detailed in the attached evaluation report.
**Broader Impact**

During 2011-2012, the Center has directly impacted more than 500 educators through its combined faculty development activities and workshops. The GTCM Model Course development workshops will have the longest and broadest impact in terms of meaningful curriculum reform among two year colleges and four year university GIS programs. The four face-to-face workshops, and two virtual workshops, in this series will have engaged more than 50 of the brightest geospatial educators in fundamental curriculum reform. While previous NSF curriculum efforts (NCGIA, 1988, 1990, 1996) have made an attempt at national impact, they have lacked significant industry involvement or support. The GTCM Model Course project began with the industry-standard GTCM and engaged more than 76 industry technicians in 5 separate DACUM workshops totaling 10 days around the nation. Combined with the activities of our 50 GIS educators, this effort has made a major impact on the state of two year college geospatial curriculums nationwide. Evidence of the significance of this effort resulted in the Center being invited to join the GIS Certification Institute’s (GISCI) Working Group (CoPI Rodney Jackson) in designing an examination component to the GIS Professional (GISP) certification process. By precisely defining the Knowledge, Skills, and Abilities (KSA) of the US geospatial technical workforce through the GTCM and MetaDACUM research, the Center has made a significant contribution to the improvement of the national geospatial workforce. This work impacted the work of geospatial educators from Queensland Australia (Dr. Ken Lyons) and the Canberra Institute of Technology (Dr. Noel Hamey), who are using the research to realign the Queensland government higher education standards for Surveying Technician education in alignment with the US GTCM standards.

**Professional Development**

The Center continued to impact geospatial educators nationwide through a series of face-to-face workshops and webinars. Topics included technology updates, curriculum development, and best-practices for academic program management. The Center expanded its collaboration with other ATE Centers, including MPICT in San Francisco and the ICT Center in Springfield MA.

**GTCM Curriculum Development Faculty Workshop Series**

The Center held a series of four workshops during the 2011-2012 that led to the development of our 10 new GTCM Model Course outlines. These events engaged between 11 to 21 geospatial faculty members in each workshop in the process of developing a curriculum of model GIS courses to match the new GTCM, published by the DOL, along with the MetaDACUM research published by the GeoTech Center. Through a carefully crafted series of pre-workshop webinars combined with intense face-to-face full day workshop, and public comment period, the Center’s CoPIs developed a highly effective workshop methodology for conducting a collaborative curriculum development process. The workshops were held in Louisville (June 2011), San Diego (July 2011), Denver (September 2011), and Sacramento (March 2012). Each workshop was co-located with another, major, GIS conference to allow the faculty participants the opportunity to leverage the GeoTech travel funds to include both our workshop and an industry conference including: 1) GeoEd’11 Louisville, 2) 2011 Esri International Conference San Diego, 3) 2011 FOSS4G Conference Denver, and 4) 2012 ASPRS Conference, Sacramento. These four workshops engage 50 geospatial educators in the development of 10 model course curricula that are now published and available for public download at [http://moodle.delmar.edu](http://moodle.delmar.edu). The server now (April 29,
2012) has 355 user accounts, ranging from US educators and industry to European and Australian educators, researchers, and industry trainers.

**GeoTech Sponsored Conference and Workshops**

In addition to the GTCM workshops, the Center continued to sponsor its annual educator workshops and conferences, as it has since 2009. These include:

The GeoEd’11 Conference and Workshops (June 2011) at Jefferson Community College in Louisville, hosted by CoPI Vince DiNoto, served more than 100 attendees and offered both GIS technology workshops as well as pedagogy best practices. The event consists of two days of four workshops and a one day conference. Chris Semerjian served as keynote speaker discussing the GTCM and its impact on geospatial curriculum.

The Southwestern College + SDSU GIS Workshop, (July 2011) co-hosted by CoPIs Ming Tsou and Ken Yanow, was a week-long workshop for 25 GIS educators from secondary schools, 2YC, and 4YC. This year the workshop included several returning participants from the 2010 cohort to allow intermediate and advanced GIS technical topics to be covered. This event is co-located during the annual Esri International Users Conference in San Diego, the world’s most attended GIS event, allowing the participants to leverage their travel funds to attend both.

**Webinars and Virtual Workshops**

Upon the recommendation of the NVC, the Center sought to broaden the scope of the impact of our webinars by engaging the services of Directions Magazine, a professional GIS online journal and webinar host. Through a series of webinars scheduled during the summer and fall of 2011, the Center was able to reach a total audience of more than 500 viewers worldwide during the two events, with several thousand views in the Directions Media archive. The July 2011 webinar was viewed worldwide and led to the collaboration with Dr. Ken Lyons of Queensland, Australia mentioned earlier.

**PARTICIPANTS**

**People**

- Phillip Davis—Principle Investigator (PI). Professor Computer Science, Del Mar College, Corpus Christi TX.
- Vincent A. DiNoto—CoPI, Dean of College and Systemic Initiatives Professor of Physics and Astronomy. Jefferson Community and Technical College, Louisville KY.
- Mike Rudibaugh—CoPI. Geography/GIS Instructor, Lake Land Community College, Mattoon IL.
- Chris Semerjian—CoPI. Assistant Director, Lewis F. Rogers Institute for Environmental & Spatial Analysis, Gainesville State College, Gainesville GA.
- Ken Yanow—CoPI. Ken Yanow Professor of Geographical Sciences, Southwestern College, San Diego CA.
- Ann Johnson—CoPI. Outreach Manager GeoTech Center, Del Mar College, Beatty NV.
- Ming-Hsiang Tsou—Senior personnel, Associate Professor Geography Department, San Diego State University, San Diego CA.
- Christine Lewis—Senior personnel.
- Amy Ballard—Senior personnel. CMS Instructor, GIT/Geomatics Applied Technologies Dept. Chair Central New Mexico Community College, Albuquerque NM.
- Amy Work—Senior personnel. GIS Analyst & Education Coordinator Institute for the Application of Geospatial Technology, Cayuga Community College, Auburn NY.
- Rodney Jackson—Senior personnel. Program Chair, Geospatial Technology Geomatics & Sustainability Division, Central Piedmont Community College, Charlotte NC.
- John Johnson—Senior personnel, responsible for performing our national DACUM research.

Organizations

Edgecombe Community College—CoPI Rodney Jackson moved from Central Piedmont Community College to Edgecombe Community College during year four of the Center. At Edgecombe, Rodney serves as the director of emerging technologies and has been instrumental in researching the potential cross-border collaboration of distance education for GIS colleges in several states including Kentucky, North Carolina, and Texas.

The Open Source for GIS (OSGeo) Foundation. PI Phillip Davis has been working with the FOSS4G organization in helping to organize an international conference in Denver, CO in September 2011 featuring free and open software for GIS. The GeoTech Center will be sponsoring a workshop on using Free Open Source Software for GIS (FOSS4G) for two year college educators during the conference, as well as presenting our research on the GTCM. This is the first time the FOSS4G International Conference has appeared in the US. It is anticipated this will lead to the wider adoption of FOSS4G application software in two year college geospatial programs in 2012 and beyond.

Central New Mexico Community College. Senior personnel Amy Ballard provides summer workshops for geospatial educators in the New Mexico region on behalf of the Center. Amy works closely with surveyors and other geospatial employers in the Albuquerque area to secure meaningful internships and work experience for your GIS students and graduates. She is an active member of the New Mexico Geographic Alliance and well-known throughout the area as a stellar geo-educator, supporting mapping projects throughout her area. She is also an active member of the ASPRS, Rio Grande Chapter.

Institute for the Application of Geospatial Technology (IAGT). Senior personnel Amy Work provides leadership in the areas of K-12 teacher education and development as well as our international program. She is responsible for the development of international research opportunities for college faculty and undergraduate students.

Environmental Systems Research Institute, Inc. (ESRI) is our major industry partner and provides unlimited access to its software, online training, campus facilities nationwide, and personnel to assist the GeoTech Center in training learners and educators about GIS application software.

Central Piedmont Community College. Senior personnel Rodney Jackson provides year-round training to workforce, K-12 educators, and learners on behalf of the Center. He also provides
access to distance learning modules and courses that will become part of our professional development offering through the resource repository.

Lake Land College. CoPI Mike Rudibaugh is responsible for our rural college internship program in Mattoon IL, where he places GIS interns with local governments in Southern IL in a variety of locations.

Kentucky Community & Technical College System (KCTCS). CoPI Vince DiNoto leads the GeoEd summer conference and workshops annually. This event brings together approximately 100-150 educators and industry representatives for GIS technology skill updating and presentations from industry and government professionals. Vince is also responsible for maintaining the national map server displayed on the Center’s website homepage.

Southwestern Community College. CoPI Kenneth Yanow leads West Coast summer institute with researcher Ming-Hsiang Tsou of San Diego State University to provide educators from secondary schools, colleges, and universities with the latest in both technology and best pedagogical practices. Ken also provides Center leadership in our Free and Open Source Software research, providing white paper reports to Directions Magazine on an occasional basis.

Gainesville State College. CoPI Chris Semerjian leads our efforts at recruitment and retention among the HBCU populations of the Southeastern US. He also provides critical support in our DACUM efforts by organizing regional DACUM workshops. He works with researcher Rodney Jackson of Central Piedmont Community College (NC) to develop DoL and NSF grants with HBCU institutions in their area. Chris is active in promoting professional development activities in the Southeastern US, including Metro Atlanta, through the URISA, Georgia Chapter.

San Diego State University. Senior personnel Ming-Hsiang Tsou leads our effort develop a new Javascript version of our national map interface. He leads a team of graduate level GIS students at SDSU in redesigning the national map program database as well as the map interface to be deployed in July 2012 on the Center’s homepage. He also participates in the West Coast summer institute with CoPI Ken Yanow of Southwestern College in San Diego.

Lake Land College. CoPI Mike Rudibaugh of has been working extensively with the Illinois GIS Association presenting workshops to their members to develop professional development opportunities to under-served GIS professionals in the rural areas of Illinois. The Illinois Statewide GIS Initiative will provide the vision for GIS leadership, coordination and services to public and private entities that serve the citizens of Illinois.

Georgia Institute of Technology (Georgia Tech). CoPI Chris Semerjian works in collaboration with the Georgia Tech in Atlanta to provide physical facilities for the GeoTech Center use. We will be partnering with Georgia Tech in May 2012 to host our first annual Geospatial Educators Summit.

Urban and Regional Information Systems Association (URISA). URISA provides professional development opportunities for geospatial educators and practicing professionals. URISA is a non-profit professional and educational association that promotes the effective and ethical use of spatial information and information technologies for the understanding and management of urban
and regional systems. It is a multidisciplinary association where professionals from all parts of the spatial data community can come together and share concerns and ideas.

**American Society for Photogrammetry and Remote Sensing (ASPRS).** CoPI Ann Johnson is working as the Center’s national business and nonprofit liaison to establish a professional relationship with the ASPRS in order to create professional development opportunities for geospatial educators and practicing professionals. Ann is working with the Education Committee of ASPRS to recognized GeoTech Center as the voice for two year college educators and provides an outlet for our participation in the Societies conferences and workshops.

**American Association of Geographers (AAG).** CoPI Ann Johnson, along with senior researchers Amy Ballard, Amy Work, and Christine Lewis are working with the AAG to promote collaboration with the AAG and GeoTech to encourage and promote professional development opportunities for geospatial educators and professionals. The AAG is one of the largest professional organizations in American for geospatial technology and can provide events nationwide relevant to the education and professional needs of two year college educators.

**GIS Certification Institute (GISCI).** PI Phillip Davis and CoPIs David DiBiase and Ann Johnson are collaborating with the GISCI to develop and vet nationwide, a set of common core competencies for the GIS Technician level job description. The GIS Certification Institute (GISCI) is a 501(c) nonprofit organization established to provide professional standards for GIS professionals on a national level. GISCI provides the world's most recognized professional certification, the GISP, exam. GISCI has developed a working group, hosted by the GeoTech Center, to work collaboratively with education and professional groups in the creation of industry-driven job descriptions for the GISCI and Dept. of Labor.

**United States Geospatial Intelligence Foundation (USGIS)** PI Phillip Davis is working with USGIF Director of Education, Dr. Max Baber, to establish guidelines for the accreditation of 2YC GIS programs by the USGIF. Currently the Foundation only certifies 4YC GIS programs and has only certified 10 university programs to date. The work with the GeoTech Center will lead to an expand certification program by USGIF, an important effort since the US federal government recently announced it would begin requiring certification of academic programs for new employees in the US Geospatial Intelligence community employed at the federal level.

**ACTIVITIES AND FINDINGS**

**Activities/Findings**

In year four, the Center engaged in several noteworthy research initiatives which will result in major changes to geospatial higher education at a national level. These major initiatives include:

1. Creation of the Geospatial Technology Competency Model (GTCM) Model Courses
2. Remote Desktop Access to Virtual GIS Applications (RDA)
3. National Database Map of Community College Geospatial Academic Programs

Each of these major initiatives is briefly described below:
GTCM Model Courses—in order to bring the GTCM to actionable fruition, it is necessary that geospatial educators be given the tools to develop their local academic curriculums in alignment with this new national standard. To that end, the Center has created a series of useful curriculum-alignment tools, including Excel spreadsheets with statistical formulas for ranking the GTCM competencies that need to be taught to learners in preparation for a the workforce. Using these spreadsheets, educators can access their current curriculum offerings and perform a gap-analysis between their existing courses and the model courses recommended by the GeoTech Center. In addition, educators require course material that contain sample syllabi, Student Learning Outcomes (SLOs), assessment matrices, and suggest course scope and sequence of major learning units. Our GTCM Model Course outlines provide each of these tools for educators to either update their existing curriculum or create new curriculum based on a national standard.

GTCM Model Course Server (http://moodle.delmar.edu)
Remote Desktop Access to Virtual GIS Applications—the Center has expanded its previous research into using remote access to GIS software via the Internet as an alternative to the complex management and administration of locally installed GIS software. This complexity has long been a barrier to the wider adoption of GIS and geospatial technology among secondary schools and many colleges who lack either the technology infrastructure or technical expertise required to install and maintain the software. By using remote access over the Internet, educators and their students are able to access GIS software directly from a remote server using nothing more than an Internet-connected computer with HTML browser. In 2011-12, we expanded this research to include a new corporate partner, Desktone, Inc., to provide nationwide access to a GeoTech-owned GIS server equipped with the latest Esri ArcGIS 10 server software and related applications. This server (http://geotech.desktone.com) is the first prototype of its kind and has allowed students and educators nationwide to access the latest GIS technology directly in the classroom with a locally managed server. It was used by partner Del Mar College in their fall and spring GIS courses with good reports from the students and faculty members on the server’s performance across the Internet. The PI expanded the experiment to include educators from around the nation and four users in Australia. All reported acceptable performance via the Internet from a wide range of Internet connections. The flexible Desktone configuration was able to meet the technical needs of educators in terms of data access, storage, and GIS processing.
National Database Map of Community College Geospatial Academic Programs—this critical database contains the contact information and academic offerings of every known 2YC geospatial program in the US. At the beginning of the fourth year, the database had approximately 450 entries. At the time of this report (April 29, 2012), the database has expanded to 680 entries. Through the sustained efforts of the Center, the database is now the single most comprehensive repository of program information in the country. The Center has redesigned the database schema to make it more responsive to the needs of future users by allowing more flexible querying. Graduate students, under the direction of partner Dr. Ming Tsou of SDSU, redesigned the database schema. The new database has now moved to a secured server housed at SDSU and is maintained by a team of GeoTech staff and partners. The SDSU team also programmed a new Javascript-based web interface that allows the database to be visualized on a variety of new devices, including Apple iOS devices, like the iPad. The previous version, based on Flash technology, while useful, was limited to browser-based computers with Flash Player installed.
Faculty at colleges and universities are requesting their programs be featured on the national map interface as a marketing tool to attract new students into their programs. They view the map as a useful tool to their potential students, parents, and counselors. The map has even drawn the attention of major industry partner, Esri, Inc. through their Education and Industry Manager, David DiBiase. At the last NVC meeting in February 2012, Mr. DiBiase made an offer to partner with the GeoTech Center to even host the map and feature it on their website as an educator’s resource. The Center is currently negotiating with Esri about financing the proposal.
New Javascript-based Map Interface (2011)

Project Training Development

The Center provided a number of educational workshops and institutes around the country in third year. The Center divided its efforts into two categories: national and regional efforts. National efforts included those aimed at the broadest possible reach and leverage partnerships with other Centers and private industry to offset the expense of travel. The regional efforts leverage the widely dispersed geography of the Center’s ten college and university partners coast to coast. A brief summary of our activities is provided:

National Training Development Activities

ESRI—GeoTech Joint Teachers Teaching Teachers GIS Institute (T3G)—Redlands CA, June 2011. The Center partnered with leading GIS software vendor ESRI, Inc. for a third year to provide an intensive week long institute for secondary and college geospatial educators. Unique to the T3G Institute is its training-the-trainer emphasis on improving experienced geospatial educator’s use of geospatial technology. Applicants are required to be highly proficient with the technology prior to joining the institute in order to focus on pedagogical issues and techniques. This highly selective institute enrolled only 40 of the more than 100 applicants who submitted a competitive application. The institute enjoys the team-teaching of the most recognized group of geospatial educators, including a number of ESRI’s K-12 and Higher Education Team, and commercial educators, Roger & Anita Palmer. To further broaden the impact of the institute, the Center engaged the graduates in a year-long series of workshop and presentations they provided to students and fellow educators in their area, covering the entire US. The 40 educators choose their
own activities through a GeoTech grant application that paid them to perform dissemination of their T3G experience through presentations or projects. The Center is partnering with ESRI again in June 2012 to repeat the T3G Institute another year.

2011 FOSS4G Conference and Workshops—Denver, CO, September 2011. The Center was a sponsor of two workshops at the FOSS4G conference, including an Introduction to FOSS4G Software, attended by 25 participants from around the country. The Center also sponsored the FOSS4G Birds of a Feather workshop which collaborated with educators from around the world, including virtual attendees from the EU.

2012 AAG Conference and Workshops—NYC, February 2012. The Center sponsored two workshops at the AAG meeting: a) Introduction to FOSS4G with 25 participants and b) Introduction to the GTCM with 15 participants.

Outreach Activities

The Center provided numerous outreach activities in all areas of the country where campuses are located. The activities range from simple classroom presentations by a single faculty member to full-day GIS Day Events, involving dozens of presenters and hundreds of participants, usually secondary school students. Events in year two included:

National GTCM Student Competition—a national competition to replace the discontinued SkillsUSA Geospatial Competition, this unique three round competition focuses on the skills and competencies outlined in the GTCM. By creating this new national competition the Center will accomplish two broad objectives: a) increase student and faculty awareness of the GTCM and b) provide a platform for promoting the awareness of two year geospatial programs and graduates to universities and industry. This is the second national competition focused exclusively on the two year college level. The first round of the competition was recently completed (April 15, 2012), and we are currently into round two. The third and final round will witness the top six student competitors presenting their projects before a live audience at the 2012 Esri Educator’s User Conference July 2012 in San Diego.

GIS Day Event @ Del Mar College—Corpus Christi TX, November 17, 2011. Del Mar College and Texas A&M University—Corpus Christi combined forces, along with Texas A&M—Kingsville, the City of Corpus Christi, and several private engineering and surveying firms, provided demonstrations and presentation of geospatial technology to more than 350 secondary and middle school students from more than one dozen school districts from a four county area.

Conference and other events

July 2011 ESRI Users Conference in San Diego CA: a team of 6 CoPIs attend the annual event and present a series of papers on the Center’s initiatives. The Center sponsors an all day expo at the Educator’s sub-conference and a half-day booth at the Academic Fair. A total of more than 350 college and university geospatial educators are directly impacted over a period of four days.
October 2011 National Science Foundation Annual ATE PIs Conference in Washington DC: The Center, represented by a team of six CoPIs, hosted a Birds of a Feather session for Geospatial Technology which was attended by 40 participants, mostly two year college GIS faculty.

PRODUCTS

Model Course Curriculum

The Center produced a total of 11 model GIS course outlines complete with syllabi, Student Learning Outcomes, learning objectives, learning objective assessment matrices, and suggested resources and scope and sequence. These curriculum materials are freely available for download in SCORM-compliant format from the Center's Moodle server: http://moodle.delmar.edu.

CONTRIBUTIONS

Within Discipline—the Center has made the following contributions:

Year Four (2011-12)

1. 11 GTCM GIS Model Course Packs
2. National GIS Academic Programs Database and Map Interface

Research and Education

The Center conducted fundamental educational research into the best practices for building and sustaining two year college academic geospatial technology programs including:


CoPI David DiBiase—conducted workshop and forums on the development of the Dept. of Labor’s Geospatial Management Competency Model (GMCM). Through his association with his URISA, the sponsoring professional organization conducting the GMCM development on behalf the DOL, Mr. DiBiase is completing the top Tier 7 of the overall Geospatial Technology Competency Model (GTCM) co-created by the Center in 2010.

Senior researcher John Johnson—conducted two DACUM workshops on Remote Sensing technology occupation and performed a statistical meta-analysis of the results producing the first-ever Meta-DACUM Analysis of Common Core Competencies for GIS Technician and Remote Sensing. This work will be incorporated into the GTCM as one of several tier 6 occupation definitions. It is also being reviewed by the GIS Certification Institute as the basis for an exam-based certification to improve their existing GISP (GIS Professional) certification.