PROJECT DESCRIPTION

THE PROJECT NEED

Engagement, capacity, and continuity are important elements of the trilogy to support children's participation in learning science and mastering technology skills (Jolly, et al., 2004). It is important to leverage resources in areas where the partnerships of educational institutions, schools, and communities can have the greatest impact on the youth for their science and technology learning opportunities and careers. Therefore, Eastern Michigan University (EMU), City of Detroit Homeland Security and Emergency Management (CDHSEM), and Detroit Public Schools (DPS) are proposing this three-year Mayor's Youth Technology Corps (MYTC) Project in Detroit.

The MYTC project offers a collaboration of resources, support, and opportunities for strengthening science, technology, engineering, and mathematics (STEM) education efforts. Such strengthening is much needed in the Detroit Metropolitan Area. Current literature reveals that classroom science engages only a small percentage of students and involves even fewer low-income, female, or minority students (Tobin, 2005). 81.55% of the total population (951,270) of the City of Detroit is African American (http://detroit.areaconnect.com/statistics.htm). The mean household income in City of Detroit is the fourth lowest ($27,871) among all American metropolitan cities (http://www.inc.com/magazine/20060501/boomtowns-sidebar-income.html). Creating and enhancing resources and exposures for 68,700 youth between 15 and 19 in Detroit to careers in science and technology is an extremely challenging but necessary task.

Moreover, the information technology field is expanding at an exponential rate, and there is no better time for youth to be part of it. Career opportunities are virtually unlimited as is the range of businesses in which computer skills can be utilized. Banking, engineering, film production, forestry, health, homeland security, manufacturing, management consulting, mining – practically every industry now uses computers and needs people to manage, use, network, or program them. Technical skills are also very portable, a circumstance that makes a career in information technology very attractive to people who like to experience different cultures. Moreover, computers and the networks that connect them are inescapably part of our lives.

But above all, information technology (IT) is about people sharing information and innovative ideas that eliminate global barriers and help increase the availability of information to everyone. IT goes far beyond standard classroom learning (or formal education). After-school programs or informal education opportunities, alternatively, are environments that can effectively inspire, augment, and reinforce science and technology learning for school children. They can create the kind of "intentional figured communities" seen as essential in Teresa Perry's theory of African-American achievement (Perry, 2003). As such, they may prove to be more optimal places of learning for minority and low-income students, as well as for girls.

THE TARGET AUDIENCE AND IMPACT

The MYTC project is targeted at high school students in the City of Detroit. 100 students recruited from all high schools in the Metropolitan Detroit will receive about 250 hours training and hands-on experience in IT and geographic information system and technology (GIS/T) during a two-year period. They will receive 21 hours training in computer foundations and software application basics, 30 hours training in GIS/T basics and applications in homeland security, 20 hours training in 2D and 3D GIS/T toolsets for critical infrastructure protection, 28 hours training and IT experience in Information Assurance, 30 hours training in Computer Emergency Response Team Operations, and 120 hours summer internship in a Detroit city department or contractor to work on a real-world project, through which they practice their skills.

Moreover, 30 hours advanced training in Computer Forensics will be provided as an option for those students who want to get in-depth knowledge and skill.

This project will have profound impacts on the high school students in the Detroit Metropolitan Area for creating cutting-edge career pathways in IT and GIS/T, providing informal STEM learning opportunities, and providing linkages to college experiences. Moreover, the collaboration in this project involves University technology researchers (expertise in IT and GIS/T), informal education agencies and champions (online education and facilitation, after-school programs, and parental connections), security concerned agencies and industries (hands-on projects and internship experiences), and public schools (student recruitment and career training). This partnership provides a sustainable model for making the ITEST activities live and be part of national efforts to advance STEM education and to explore new ways to train our 21st-century working force. Therefore, this project will serve as a national model and broaden its impacts to the national level.

THE PROJECT GOALS

This project has four important goals.

1. **Create career pathways for two cohorts of 50 students (100 total) in IT and GIS/T application-development response to homeland security needs.**

The MYTC project is designed to provide academic foundations and cutting-edge technical skills for a professional GIS/T and IT career in law enforcement, fire fighting, emergency management, and homeland security. Two interrelated IT-based training and application experiences will be provided to students: GIS/T-based critical facility management tool-kits (GIS/T-CFMT), and the IT-based cyberspace security training modules (IT-CSTM). GIS/T-CFMT includes 2D and 3D computer models that are developed to assist first-responder teams to handle emergency situations at critical infrastructure sites. These innovative and creative GIS tools streamline interior and exterior drafting, designing, 3D visualization, measuring, evacuation routing and planning, and link with floor plans and facility descriptive data into "geo-database models" to support real-time (or near real-time) emergency responses. IT-CSTM consists of three IT-training modules: Information Assurance, Emergency-Response Team Operations, and Computer Forensics, which will teach important IT skills to comply with the *National Strategy to Secure Cyberspace*.

The students will gain skills through hands-on experiences and internships designed and supervised by distinguished GIS/T and IT researchers, technologists, and educators. Upon completion of the program, the students will receive a "Completion Certificate" jointly issued by the Environmental System Research Institute, Inc. (ESRI), the world's leading GIS/T software designer and developer, and Eastern Michigan University. This certificate, recognized and respected by the GIS/T industry, will help students in seeking employment.

2. **Provide students with inquiry-based STEM learning opportunities in the informal setting of after-school programs and summer internships.**

GIS/T-CFMT 2D and 3D toolsets involve geometry, trigonometry, computer-aided drafting and design, visualization, database management, and network analysis. IT-CSTM introduces voice and data network connectivity, modem security, VOIP security, wireless security, cryptography, intrusion-detection systems, hardware identification, TCP-IP, rules of electronic evidence, network investigation, digital evidence, case management, etc. Learning these STEM concepts is embedded in inquiry-based experiences. Moreover, the MYTC project will create excellent opportunities for students to better use their after-school and summer hours in purposeful learning activities. In addition to significantly strengthening STEM aptitudes,

students will learn real-life skills in application development, communication, problem-solving and critical thinking, leadership and teamwork, ethics, and responsibilities.

3. **Provide college experiences for the students.**

Eastern Michigan University (EMU) is committed to providing high-quality learning experiences to students in Michigan, particularly in southeastern Michigan (Metropolitan Detroit. EMU has instituted many cooperative agreements with school districts and educational organizations regarding dual-enrollment. For instance, during this team's (Yichun Xie, Randall Raymond, Beverly Hunter) previous NSF project, the Virtual Immersion in Science Inquiry for Teachers (VISIT) project (NSF Award # 9911792), EMU offered credits to teachers who completed VISIT online-training modules. EMU has begun discussions with the Detroit Public Schools about dual enrollment (EMU-DPS) for three IT-CSTM training modules. Upon completing these trainings, students will have an option to receive nine (9) hours of college credit toward advancing their higher education at the College of Technology, Eastern Michigan University.

4. **Enhance students' access to high-quality IT and GIS/T resources and research experiences focused on homeland security applications (including powerful 2D and 3D critical facility management tool-kits).**

EMU's Institute for Geospatial Research and Education (IGRE) has a long history as a University research center (previously CEITA: Center for Environmental Information Technology and Application) in developing innovative applications of GIS technologies to practical problems. IGRE maintains a group of highly motivated and professional GIS/T researchers and post-doctoral fellows. They collaborate with researchers at many universities and U.S. government agencies in developing spatial modeling, geo-computation, and GIS analytical tools and methods to support informed decision making for IGRE's partners and communities. In recent years, IGRE has developed several crime-mapping and homeland security-related toolsets. For instance, the online sex offender query and validation system enables users to check whether an offender's address is within the legally prohibited safety zone (1000 feet) to a school (http://geodata.acad.emich.edu/pso/). IGRE has a collaboration agreement with Pictometry International Corporation and has developed several applications integrating Pictometry images for critical facility management (e.g., Mayor's Dashboard for City of Detroit, http://geodata.acad.emich.edu/mayordashboard/ and Detroit Public School Facilities and Land Management Information System, http://geodata.acad.emich.edu/realestate/).

EMU's Center for Academic Excellence in Information Assurance (CAEIA) plays an important role in IT training for law enforcement agencies. Professor Gerald Lawver, Director of CAEIA, is the founder of the Information Assurance (IA) Bachelor-Degree Program at the EMU College of Technology, which contains three concentrations, IA Management, Applied IA, and IA Encryption. His insights into emergency response and security operations and his contacts with law enforcement agencies will be instrumental in understanding how emergency responders think, work, and use technology to solve problems. The IT training and experience in IA will be important elements of this project, in addition to GIS/T.

THE PROJECT DESIGN

I. The Project Design Principles

The design of this project follows three principles. First, **the IT field is expanding at an exponential rate, and career opportunities in IT are virtually unlimited**. The digital divide is widening, however (Servon, 2002). Special efforts must be made to provide these opportunities to the students from under-represented groups.

Second, **engagement, capacity, and continuity** form the trilogy of elements that support children's learning of science and their mastering technology skills (Jolly, et al., 2004). **Engagement in purposeful learning experiences**, which lead to meaningful career development, is the most important guideline in determining the subject areas of this project. *The National Strategy to Secure Cyberspace* and *National Strategy for the Physical Protection of Critical Infrastructures and Key Assets* concisely point out the rationale of our selection of two interrelated IT fields as the focused IT experiences of this project (The National Strategy to Secure Cyberspace, 2003).

The National Strategy to Secure Cyberspace is part of an overall effort for implementing *The National Strategy for Homeland Security*. Cyber Crime is fast becoming the number one crime investigated in the country. Investigations require the recovery of digital evidence with the use of specialized software. Critical to the security of our nation's information system is the ability to forensically examine seized electronic media. The ability of law enforcement to investigate and prosecute cyber-related crime will depend upon an agency specifically trained and expert in this extremely technical area. Securing cyberspace is a difficult strategic challenge that requires coordinated and focused effort from our entire society - the federal government, state and local governments, the private sector, and the American people.

National Strategy for the Physical Protection of Critical Infrastructures and Key Assets calls for extensive research and application of GIS/T in homeland security. National attention has been given to this rich and interdisciplinary state-of-the-art technology and its social responsibility (Getis, et al., 2000). Federal and state governments have taken many initiatives for promoting application development and demonstration projects in these applied research fields (Stoe, et al., 2003; Eck, et al., 2005). At present, however, partially due to the high cost of data capture and partially because of the limitations of current GIS data structures and functional algorithms, features like parks or university campuses often appear as a single polygon or area on a map without any "internal" detail. Building footprints do not indicate how many floors a building has or what the floor plans look like or how the evacuation plans involving multiple levels can be solved systematically. A new direction in crime mapping and security analysis of critical facilities is to describe and understand the spatial analysis of our three-dimensional world (Rengert and Lowell, 2005).

The **capacity element** of this project comes from the interdisciplinary strength and the collaboration between stakeholders. The project team includes internationally recognized GIS/T researchers, distinguished technologists and educators, information assurance IT specialists, online education specialists, and community leaders. The students will learn from these experts computer foundations, basic concepts and skills of GIS/T and IT, computer-aided drafting and designing, geometry, math, JAVA, and Internet mapping. The students will participate in the development, construction, testing, installation, application, and documentation writing of the 2D and 3D facility management tools, all related to homeland security applications The capacity building requires a strong collaboration among the project stakeholders in Metropolitan Detroit and those in the GIS/T and educational arenas. The partners will provide internship opportunities and develop hands-on application projects for the students as they acquire new technical and conceptual skills. These internships and experiences will lead toward career opportunities for students.

The **continuity concept** guides our design of the project activities. The contents are arranged incrementally and sequentially. Students will begin by training in computer fundamentals. They will then proceed through basic, intermediate, and advanced levels of training.

The third principle is that **geospatial analysis supports growth in many core science process skills** as articulated in the National Science Education Standards (CSMEE, 1996, p. 147-148). Recent research shows that adding spatial representations to text promotes greater understanding of underlying facts (Wiegand, 2006). For instances, the use of interactive representations such as those enabled by a GIS/T promotes deeper cognitive engagement, including the ability to investigate phenomena at different scales, linking spatial position with quantitative attributes, and summarizing data in tables and graphs (Hunter and Xie, 2001). Thus, GIS/T holds great promise for deepening and extending student learning. Students, through the well articulated training and internship modules in this project, will engage in quantitatively rich geospatial thinking.

II. The Project Components

This project has five primary delivery components from the perspectives of the students' IT experiences: 1) summer short course in computer fundamentals and basic skills; 2) after-school training in GIS/T operation and analysis skills with a focus on homeland security applications; 3) after-school experience in 2D and 3D GIS/T applications in critical infrastructure protection; 4) after-school training in IT in cyberspace security; and 5) summer internships developing projects on critical infrastructure protection and cyberspace security.

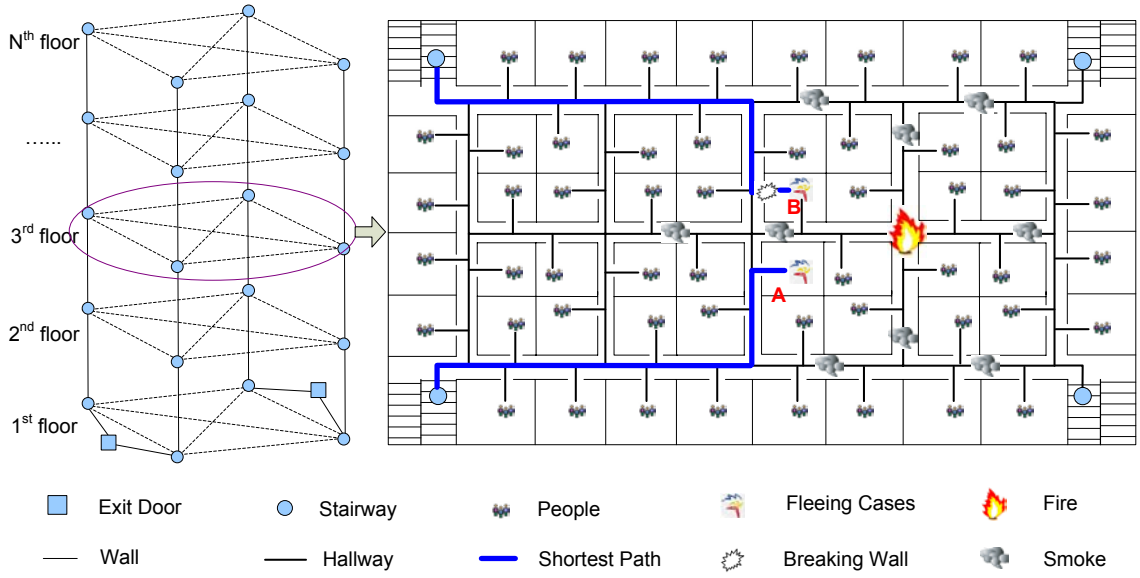
1. Summer short course in computer fundamentals and basic skills (21 hours). This is the beginning phase of the IT experience for students. In conjunction with the project orientation, this short course will prepare students with basic computer and software application skills to prepare for the MYTC program. Considering that the students are quite heterogeneous with respect to the skills and knowledge they have at the outset of the program, this course will introduce the fundamentals of desktop computers, ArcGIS Get-Started, spreadsheet software (simple database management), and use of a Web browser. Moreover, a hands-on assessment task will be conducted at the beginning of this course, to identify what the individual students already possess in the way of skills and knowledge related to the requirements of the program, and also to assess overall what needs to be taught in the beginning phase (including the summer short course and the after-school GIS/T training that follows in the Fall semester) so that all participants can be brought up to a common starting level of basic skills and fundamentals. The contents of this short course will be derived from the computer foundation course developed in EMU's CAEIA IA Bachelor's Degree Program. EMU IGRE will provide the ArcGIS Get-Started module on the basis of an ESRI short course.

2. After-school training in GIS/T operation and analysis skills (30 hours). This training includes two parts. The first course (24 hours) is "Learning ArcGIS Desktop." This course introduces general concepts of GIS and the major functionality contained within ArcGIS Desktop software. In course exercises, students follow the GIS analytical process and work with a variety of tools to solve realistic problems. This course will enable students to have practical GIS skills. The second course (6 hours) is "Analyzing School Safety Using GIS." This course examines how GIS applications apply to public safety. Collective analysis of data on crime, disorder, and truancy may help law enforcement and school officials devise strategies to address problems and enhance school safety. This course teaches how to use GIS software to map and analyze school, police, and geographic data. Students learn how to identify safety issues and use GIS as a decision-making tool. Both courses will be ESRI's virtual campus courses. The online tutoring and technical guidance will be led by Dr. Lewandowski, the MYTC project online coordinator.

3. After-school experience in 2D and 3D GIS/T applications in critical infrastructure protection (20 hours). This experience training module is based on the 2D and 3D GIS/T

toolsets for critical infrastructure protection applications that were originally prototyped at EMU-IGRE. These tools will be modified and further developed in the MYTC project to suit students' learning curve. The IT professionals, who work with these tools for producing the first responder plans, will serve as mentors. Simulations in a real-case application for evacuation planning and emergency response options will be deployed to lead students to process complex problem solving and to learn critical thinking skills. This GIS/T experience crystallizes the intellectual merit of the MYTC project.

From the critical-thinking point of view, this emergency-response modeling involves a multi-level (3D) shortest path network solution. For instance, this decision process takes the following steps: a) hallways on a floor in a building are treated as highways or street networks; b) offices (and people in those offices) on that floor become incidents from which evacuations should be originated; c) stairways (because elevators are usually not permitted for use in emergencies) on that floor are treated as facilities to which the incidents should move, or be carried, and so they serve as entryways or exits; d) emergency events and affected areas on that floor are treated as barriers, which block evacuation routes and should be avoided when selecting evacuation routes; e) determining the safe and shortest routes "from incidents to facilities" (or "from offices to stairs") on that floor will be solved by standard GIS network algorithms (Route A in Figure 1); and f) emergency events can happen on multiple floors. The solution at each floor only resolves a sub-network problem. The total solution to "this multi-level (3D) closest facility problem" can be solved in a "sequential manner."



In an emergency situation, however, emergency events could happen at various locations and affect access to evacuation routes. In the worst situations, stairs (entry-ways and exits) and hallways (the network) on certain floors may be blocked by "emergency events ("barriers") without escape options. In this case, some new pathways, entryways, and exits must be created. Therefore, the modeling toolsets must be "interactive," enabling users to determine "new ways out" by breaking separation walls to create new hallways or breaking floors to create new stairways, or using windows as new stairways (Route B in Figure 1).

This training module includes several sections that deal with various steps. For instance, a sample breakdown includes:

- **6 hours** to train Real-Time Editing Tool for 2D floor drafting and for determining potential connectivity between rooms, hallways, stairways, elevators, and doors;
- **6 hours** to learn the Network Analysis Tool to map the shortest evacuation route on a floor;
- **8 hours** to learn the Multi-level (3D) Modeling and Visualization Tool to solve and display the multiple-level evacuation route.

4. After-school training of IT in cyberspace security (CS). This training includes three short courses, which will be modified from the same courses that are part of EMU's CAEIA IA Bachelor Degree Program.

- **Providing IT experience and training in Information Assurance** (28 hours): This initial course presents a study of security in both voice and data networks. Topics covered include voice and data network connectivity, modem security, VOIP security, wireless security, cryptography, intrusion detection systems, voice and data firewalls, malicious software, information operations and warfare, and denial of service attacks.
- **Training in Computer Emergency Response Team Operations** (30 hours)**:** This course is designed to prepare students to become effective cyber-crime investigators. The course examines the basic steps required in hardware identification, TCP-IP, rules of electronic evidence, DOS, network investigation, case management, and intrusion detection.
- **Computer Forensics (Optional,** 30 hours**):** This course addresses methods of Computer Forensic Investigations. Students will evaluate and synthesize technical and legal issues in relation to digital evidence. Students will apply various skills and techniques, combined with numerous investigative software tools to analyze seized electronic media. Students must complete the first two courses prior to taking this one.

5. Summer internships developing projects on critical infrastructure protection and cyberspace security (120 hours). During their second summer, students will have two internship options. The first is with a partnering agency or collaborating city department to develop and model GIS/T applications in critical infrastructure protection or IT applications in cyberspace security. The project team, will work out an arrangement on behalf of the student, and follow up with this student and the hiring department or company for a performance assessment. In the second option, students will be organized into groups working on a 2D-3D GIS/T critical infrastructure protection project that is arranged for the Detroit Public Schools or a City department. In this case, the project leadership team will enter an agreement about technical specifics and provide support and guidance for the student groups.

III. The Project Expectations and Deliverables

One hundred (100) students will receive 130 hours training and hands-on experience in computer foundations and software application basics, GIS/T basics and applications in homeland security, 2D and 3D GIS/T toolsets for critical infrastructure protection, information assurance, computer emergency response team operations, and computer forensics. Moreover, they will participate in 120 hours problem-solving summer internships. The students will have basic IT and GIS/T skill sets to be qualified for IT-related employment in agencies and industries that deal with homeland security and emergency management.

The MYTC-Detroit project will produce a STEM Education-Oriented 2D &3D GIS/T Toolkits and the supporting training manual and user guide, a minimum four (4) case studies of critical facility management plans in City of Detroit supervised by emergency IT professionals but prepared by the students, three online GIS/T training courses focusing on emergency management applications, three IT training modules customized for cyber-space security, and, the most significantly, the collaboration model among the university technologists, school educators, agency's informal education advocates, and IT and GIS/T professionals. All of these

will be valuable products for dissemination, which will bring up greater societal impacts on STEM education and enhance students' IT experiences.

THE PROJECT RECRUITMENT PLAN

A comprehensive recruitment plan is designed for this MYTC-Detroit project. Four methods of recruiting students will be arranged: 1) The existing after-school and summer programs, such as the Public Safety Academy run at DPS four career technical centers, and the TEEN CERT program and the Fire Academy run by CDHSEM, will be leveraged for recruiting students (For details see the section of The Partners); 2) DPS, through its Office of Community Relations and the parents associations across the district, will make special presentations to parents and invite them to advocate the MYTC project and to encourage their children to participate; 3) the MYTC project team will, through DPS career technical centers, send out the project marketing flyers to all DPS high schools as a part of their program offerings; and 4) the MYTC team will join various city departments and industrial partners to send out announcements about the MYTC internships and the after-school trainings that are pre-requisites for the internships.

Moreover, five strategies will be deployed by the MYTC team to retain the students. First, a hands-on assessment will be conducted at the beginning of the summer short course as a pretest for evaluation purposes (For details see the section of The Project Evaluation). The summer short course is designed as a sort of assessment, and its final test will be used as a way of identifying gaps in the students' knowledge that may have to be remediated before they can move on to the second phase of training. Second, teacher advisors and technology tutors, in addition to the online facilitation, will be assigned at the four DPS career technical centers to provide additional guidance and tutoring to those students who lack computer skills so that they could have a chance to stay with the program and not just drop out from frustration. Third, the contents of the training and the internship are based on emerging technologies and societal needs, which embed cutting-edge IT experiences with promising career pathways. Fourth, strong incentives will be instrumented to encourage students to complete the program. Each student will receive $1,200 for completing a summer internship working with one recommended city department or agency in Detroit, $150 for finishing the summer short course in computer foundations and software application basics, $100 for completing the 30 hours training in GIS/T basics and applications in homeland security, and another $100 for finishing the 30 hours training in Computer Emergency Response Team Operations. Fifth, a college dual enrollment credit option will be provided by the EMU College of Technology.

THE KEY STAFF, CONSULTANTS, AND ADVISORS

Dr. Yichun Xie, Project PI, is the Director of the Institute for Geospatial Research and Education at Eastern Michigan University. Dr. Xie is a geospatial technology specialist who has 15 years of experience developing computerized modeling software packages and GIS/T applications. He served as PI and Co-PI for the NSF-VISIT program and the NSF-Worksite Alliance program. He will serve as Director of the MYTC-Detroit project, and devote about 15% of his time to leading this project implementation, designing / developing the 2D and 3D critical facility management toolkits, and managing the project.

Ms. Brenda Ice, Emergency Management Coordinator, City of Detroit Homeland Security and Emergency Management, will serve as Co-PI of MYTC-Detroit, providing the agency's support from homeland security related government agencies and private contractors, and serving as a liaison between MYTC and City of Detroit Departments of EMS, Fire, Police and Water. She, teaming up with Mr. Raymond, will cooperate with Detroit Public Schools and School Parent Associations to invite the inputs from the students' parents.

Roland Moore, DPS Chief Technology and Information Officer, will serve as the Detroit Public Schools point of contact and liaison for this MYTC project. He will assist to select four (4) Career Technical Centers located strategically throughout the City of Detroit and make the technology resources of those centers available to this project. He will also work with DPS Parents Associations and other DPS offices to provide political and resource support for recruitment.

Gerald Lawver, Professor of Technology, Director, EMU Center for Information Assurance. Gerald is responsible for providing IT experience and training in computer emergency response team operations, information assurance, and computer forensics; for working with Detroit Public Schools to set up the dual enrollment agreement; and for coordinating with Detroit Homeland Security Department to bring the first responders' experiences and skill sets to the MYTC training modules and internship projects.

Randall Raymond, Senior GIS Specialist in the Detroit Public Schools (DPS). As DPS GIS/T coordinator to MYTC-Detroit, he will devote about 10% of his time to coordinating the support from DPS to this project, and recruiting teachers, students, and parents. He will also manage the access codes for the DPS participating students to the ESRI Virtual Campus courses, and collaborate with City of Detroit agencies and organizations about GIS/T internships and 2D and 3D critical facility management applications.

Dr. Al Lewandowski, Authorized GIS in Education Trainer by ESRI, Inc., serves as MYTC online after-school GIS/T training facilitator. Responsible for supervising GIS/T training modules, after-school online tutoring and facilitation, and student learning experience advising.

Dr. Michael Phoenix, Manager of ESRI Education Program, serves as a liaison between ESRI and the Mayor's Youth Technology Corps project team. Dr. Phoenix advices MYTC Team to develop the training modules and to design internship projects according to cutting-edge GIS/T skill sets for the 21st Century.

Ms. Pamela Shivers, Resource Specialist, City of Detroit Homeland Security and Emergency Management (CDHSEM). She will spend about 10% of her time as homeland security specialist to provide CDHSEM IT professional experiences into MYTC and to coordinate with the contracting industries to arrange summer internships.

Xiaolin Luo, IGRE's Senior GIS Developer and Ph.D. student in the EMU College of Technology, is responsible for coding and modifying (developing) the 2D and 3D critical facility management toolkits, conducting the 2D and 3D training, and providing technical support to the MYTC students for applying the tools in the internship projects.

David Reider, principal of Education Design, LLC (www.educationdesign.biz), will provide external evaluation for the project. Since 1999, Education Design has conducted program evaluations for science and mathematics projects for K-12 and post-secondary stakeholders, funded by the U.S. Department of Education, NSF, NASA, and private foundations. He was recently a co-author and lead designer of the online Earth System Science Design Guide, to which he contributed a section on STEM skill acquisitions and minority populations. He was a visiting associate professor of Digital Literacy at The University of Massachusetts, Boston, where he developed college programs to bridge the digital divide.

THE PARTNERS

Our partners include law enforcement and homeland security agencies, informal and formal education organizations, and the IT and GIS/T companies and business firms (civil engineering, construction, planning, etc.) that collaborate with these organizations. City of Detroit Homeland Security and Emergency Management (CDHSEM) serves as a business partner for this project. CDHSEM contractors, ISAC and Codespear, are IT providers for

homeland security applications. Moreover, CDHSEM cooperates with a group of Detroit Public Schools (DPS) students on the TEEN CERT program. CDHSEM also runs a summer student program, the Fire Academy (Summer Program). CDHSEM will provide IT and GIS/T experience opportunities, and the skill requirements from the perspectives of first responders.

Detroit Public Schools (DPS) will serve as an education (both formal and informal) and business partner for this project. DPS will provide access to the four (4) Career Technical Centers located strategically throughout the City of Detroit and the technology resources of those centers. In addition to DPS' role as a formal educator, DPS runs an after-school program, the Public Safety Academy, at its career technical centers in collaboration with the Mayor's Office, Police Department, Fire Commission, and Wayne County Community College. This Academy focuses on the skills that students need to learn to become "home-grown heroes." These skills include communication, problem solving and critical thinking, information technology applications, safety, health and environment issues, leadership and teamwork, ethics and legal responsibilities, employability, and career development. DPS also works with various city departments in public safety and public engineering to provide summer internship opportunities.

Furthermore, DPS has created a culture for action and advocacy that involves diverse parent associations in the City of Detroit. DPS regularly organizes meetings with and training seminars for parents, where the parents are guided toward becoming strong advocates for their children and communities. DPS, through its Office of Community Relations and the parents associations across the district, will provide recruitment mechanism and sustainability measures to the MYTC program. We will invite the parents for their input at each step, including the selection of IT and GIS/T contents, the encouragement for their children to participate in this program, the support and leverage to the City of Detroit departments and companies for providing student internships, and the evaluation and dissemination of the project outcomes. DPS, through its Facilities Department, will assist with the identification and selection of the school facilities that will serve as the pilot school sites for the development of the 2D and 3D models. DPS will also collaborate with the MTYC partners to solicit potential matching summer internships.

In addition to the stakeholders in the Detroit Metropolitan Area, we maintain a strong relationship with and support from the Environmental System Research Institute, Inc. (ESRI), the world's leading GIS/T software designer and developer. ESRI also serves as an informal educational partner and a business partner for the MYTC project. ESRI will help identify high-tech educational needs for the 21st Century workforce from the GIS/T and IT perspectives. ESRI will identify a suite of training modules from ESRI Virtual Campus for the MYTC after-school training programs for basic GIS/T skills and GIS/T-based homeland security applications. ESRI will review and assess the training modules developed by the MYTC Team focusing on homeland security applications, and the internship projects supported by MYTC. In combination with ESRI-selected Virtual Campus modules, ESRI, jointly with EMU, will issue a "certificate of completion" to the participating students, acknowledging these students' competence with purposeful GIS/T application experiences in public safety, emergency response, and homeland security. The certificates endorsed by ESRI will help students seek and obtain meaningful employment opportunities in the GIS/T and IT fields, and contribute to the sustainability to the MYTC project.

THE ANCILLARY MATERIAL

The MYTC-Detroit team will maintain a project website. The development and maintenance of this website will be part of IT experience for the students. Moreover, this website

will become a depository for disseminating the toolkit, the students' case studies, training and educational modules.

THE PROJECT EVALUATION

David Reider, principal of Education Design, LLC, will lead the external program evaluation efforts. The evaluation plan will be formative in design with annual summative reporting. Continual feedback (formative design) to the design team is critical to guide the project efficiently, especially during its startup phases. Feedback will occur through regular conference calls, online posting, and site-visits.

I. Evaluation Objectives

The evaluation is concerned with three primary objectives: 1) To help the project team implement and lead the project effectively through ongoing design and operational modifications to best meet the project goals; 2) To help document activities for continued learning by project team and related professional fields; 3) To help ensure that the interventions continue to evolve and thrive after the formal period of performance.

The evaluation will place all observations and findings within the contexts of engagement, capacity, and continuity. **Student engagement** is a key indicator of participation, motivation, and a strong predictor of success. **The Capacity** of the student is a measure of increased intellectual growth as participants move from one experience to the next: much of the program's success will rest upon students' capacity to absorb successive levels of knowledge. **Continuity** is a measure and predictor of sustainability. If students are able to demonstrate continued interest and probability for self-direction, and partners acknowledge and support this continuity of interest, the program, or key elements, will likely be sustained beyond the funding period.

II. Student Learning Outcomes: Evaluation of Project Goals

In collecting and analyzing data, the evaluation will emphasize student learning outcomes tied to each of the key project goals:

1. **Career Pathways:**

- **Evaluation Learning Objectives:** We will be learning not only how many students receive an ESRI Completion Certificate, but what the process includes to obtain that knowledge, what the student knows about career opportunities, and what steps have been taken toward beginning or continuing along appropriate pathways.
- **Instruments developed and used:** Biannual surveys (fall/spring), student population sample interviews (spring) each year, and interviews with academic counselors at participating students' schools. (Year 2, Year 3)
- **Main questions asked:** Is there an increase in career awareness and interest in the IT and GIS/T fields? As the field relates to and supports homeland security? Does participation in this program, including obtaining the ESRI Completion Certificate predict entrance into related career fields? Do students perceive themselves as members of an intentional community created by this project?

2. **Provide inquiry-based learning opportunities for students to learn STEM skills**

- **Evaluation Learning Objectives:** We will be assessing to what extent students are acquiring STEM skills through after-school and summer programs. The increase of STEM literacy in the ITEST target population will be a critical indicator of the project's ultimate range and impact.
- **Instruments developed and used:** Analysis (content and curriculum analysis, student work analysis, activity observation, data garnered from course/activity assessments). These data

will be gathered at the end of each activity period: the end of semesters for after-school activities, and the end of summer for internships.

- **Main questions asked:** Are students acquiring STEM skills? Which of the critical IT and STEM concepts and skills did students exhibit after participating in the trainings? Were these sufficient to enable them to contribute to the building of a usable navigable 3D building model? Is there a greater degree of STEM literacy in the participating student population as compared to a control (non-participating students in same schools) ?

3. Provide college experiences for the students

- **Evaluation of Learning Objectives:** We want to know if (and under what conditions) students will participate in EMU's 9-hour course offering at the College of Technology and if so, why they enroll. Providing college experiences for students cannot be an end unto itself, but rather a stage in the advancement of academic and professional growth.
- **Instruments developed and used:** Data collected from project team and schools on participation and completion, interviews (end of course) with students and course instructors. (Year 2 and Year 3)
- **Main questions asked:** To what extent will students participate in EMU's 9-hour course offering at the College of Technology? Will success in the course predict continued interest and activity in the ITEST program and lead toward further study and possible careers in IT and GIS/T? Will this pre-college experience predict an increase in college enrollment by the target population?

4. Enhance student access to high-quality IT and GIS/T resources related to homeland security applications

- **Evaluation Learning Objectives:** The project will provide access to rich IT and GIS/IT resources at EMU through the Institute for Geospatial Research and Education as well as the potential for students to collaborate on projects with world-class research scientists. Will this access provide the necessary stimulation and motivation for students to increase their STEM skills, and enter the IT and/or law enforcement career pathways described in this project? Will this resource be utilized?
- **Instruments developed and used:** data collected from interviews with project leaders, IGRE personnel, and students. Data will be collected each year and tracked over time.
- **Main questions asked:**
  - **i.** (to students:) To what extent has this experience and access helped you decide upon a future course of study? What have been the key motivators from this experience? Is this type of partnership/collaboration a viable model for increasing and sustaining interest in these fields?
  - **ii.** (to collaborators:) What roles did students play in the development, construction, testing, installation, application, and documentation of the school building demonstration projects? Has working with students changed how you present your work and findings? Is this type of partnership a viable model for increasing interest in the field from today's HS students? Is there a change of interest in law enforcement career options because of this access?

III. Evaluation of Project Components: Operational Documentation

The evaluation will also document the growth and development of each project component, including recruitment strategies and numbers, parental involvement, frequency, completion and dropout rates, numbers and types of simulations and models created, and changes in students' academic standing at their schools. We will collect this data from:

1) Summer short course of computer fundamentals and basic skills (collected end of summer)
2) after-school training of GIS/T operation and analysis skills with a focus on homeland security applications (collected end of semester fall and spring)
3) after-school experience of 2D and 3D GIS/T applications in critical infrastructure protection (collected at the end of semesters of fall and spring)
4) after-school training of IT in cyberspace security (collected at the end of semesters of fall and spring)
5) summer internships developing projects on critical infrastructure protection and cyberspace security (collected at the end of summer)

IV. Timeline

In the first period of the project, the evaluators will develop with the project principals a set of measurable indicators and baseline characteristics of students recruited for the program, such as age, home address, school, grade level, and academic and career interests. A database will be set up to record these dimensions, and a set of procedures for regular recordkeeping and updating of the database will be recommended to the project staff. Interviews will be conducted with students, instructors, and lead project personnel, via online interactions and face-to-face, on a schedule described above. There will be four site visits per year by the evaluators: during the summer internship period, at the end of each academic semester, and once to meet with the project team to discuss findings and design changes. At the end of each project year, a report will summarize what has been learned on the basis of the quantitative and qualitative analysis of the surveys, the database, and the interviews. Findings will inform the modification of instruments and data collection methods for the following year. A Year 3 final report will summarize both the third year and the entire project.

The project evaluators will support the evaluative research on the impact of the ITEST program that will be conducted by the ITEST Resource Center by providing requested data and metadata to the ITEST Resource Center.

THE DISSEMINATION

The dissemination plan consists of three methods and three channels. The three methods of dissemination include: Virtual Dissemination - all materials developed and acquired through this project will be collected in the online collaboratory open to all interested audience; Local Dissemination - the tools and critical building databases will be accessible to the homeland security and law enforcement agencies as assistance to their first responders' activities; and National Dissemination - the project findings, lessons and experiences will be submitted to STEM, homeland security, and spatial technology-related conferences. The three channels of dissemination are 1) DPS Career Technical Centers will present this informal IT and GIS/T training model to other school districts across the nation through school and education conferences and publications; 2) EMU technologists and educators will publish and present their findings from technical perspectives for conducting IT and GIS/T training and applications to GIS/T and IT professional communities; and 3) CDHSEM will disseminate the 2D and 3D toolkits and the procedures of using these tools for managing critical facilities to the homeland security and law enforcement agencies and their sub-contractors.

THE TIMELINE

The MYTC will train two cohorts of students (50 each). Each cohort will start with the summer short course, kicking off the program and making the students prepared in computer knowledge and skills. The activities are, according to school schedules, organized into three periods per calendar year: 1) the winter semester after-school training (January – May), 2) the

summer short course or internship (June – August), and 3) the fall semester after-school training (September – December). The program activities and schedules are similar for these two cohorts, except that the second cohort will start one year later than the first cohort. The timeline for Cohort I is listed in the following table, and the details can be referred to a previous section - The Project Components.

January – May 2008	**June – August 2008**	**September – December 2008**
• Organizing the MYTC team and signing agreements between the MYTC partners; • Selecting and modifying GIS/T training modules; • Selecting and modifying IT in Cyberspace Security training modules; • Designing and developing the MYTC Website; • Working with Detroit Public Schools to sign an agreement of dual enrollment credits with EMU College of Technology; • Modifying and re-packaging 2D & 3D critical facility management toolkits for enhancing the complex problem solving.	• Recruiting students in Detroit Public Schools through Detroit Public Schools, and Detroit Parents Action Network; • One week summer short course to kick off and make students ready technically for the MYTC program (7 hours * 3 days = 21 hours); • Developing a uniform interface for integrating the MYTC training modules and the selected ESRI Virtual Campus courses into the MYTC Website; • Developing training modules for the 2D & 3D critical facility management toolkits.	• Conducting after-school online training sessions in GIS/T in 3 selected Mayor's Time computer labs (3 hours * 10 weeks = 30 hours); • Communicating with the partnering organizations to identify and to set up internship agreements; • Recruiting the participating students to maintain and build up the MYTC Website • Recruiting the participating students to assist in writing training manuals for the 2D & 3D critical facility management toolkits.
January – May 2009	**June – August 2009**	**September – December 2009**
• Conducting application training for using the 2D & 3D critical facility management toolkits (20 hours); • Conducting the training course, IT Experience in Information Assurance (28 hours). (3 hours * 16 weeks = 48 hours).	• Doing internships for 6 weeks for the projects related to GIS/T and IT-in-Emergency applications in the partnering city departments and / or their contractors (20 hours * 6 weeks = 120 hours)	• Conducting the training course, Computer Emergency Response Team Operations (30 hours); • Conducting the training course (Optional for students), Computer Forensics (30 hours) (4 hours * 15 weeks = 60 hours)

THE SUSTAINABILITY

We have thought vigilantly about the sustainability of the MYTC-Detroit project activities from its design process and implementation plan. First, the DPS Career-Technical Centers (CTC) will implement the MYTC after-school training program as the pilot project for establishing the Geospatial Technology Academy (GTA). GTA will be a permanent (long-term) program at DPS-CTC. The sustainability of GTA will be maintained by three sources of support: 1) it is a DPS-CTC sponsored program; 2) there will be a dual enrollment agreement between DPS and the EMU College of Technology, which will provide incentives for students to participate; and 3) DPS-CTC has received the support from the industrial and foundation partners for its programs, and GTA will be an innovative program that will attract more support. DPS-CTC and EMU will work together to set up a sustainable model of running GTA.

Secondly, City of Detroit Homeland Security and Emergency Management (CDHSEM) and its industrial sub-contractors have provided paid-internships to some of its school outreach programs. The MYTC project is providing cutting-edge IT & GIS/T experiences to students and preparing them with very employable skills in IT and GIS/T fields, which are in great demand for cyberspace security and critical facility management. Thus, CDHSEM feels confident that there are and will be more paid internships to the students with these skill sets and is committed to organize this effort.

Third, ESRI (the world's leading GIS/T software designer and developer) and EMU-IGRE (a leading university GIS/T research center that has broad contacts with government agencies and industries in Michigan) will jointly issue the "Completion Certificate" to the participants. This certificate will help students in seeking paid internships, and employment opportunities. This will be another level of leverage for sustainability.

THE RESULTS FROM PRIOR SUPPORT

In 2000, Dr. Xie, as the PI, received the NSF Teacher Enhancement Program funding for four years for the Virtual Immersion in Science Inquiry for Teachers (VISIT) project (NSF 991792; http://igre.emich.edu/visit/). This is an Online Collaboratory for secondary school science teachers to participate in ongoing scientific investigations of contemporary problems in their localities through applying spatial analysis technologies (GIS). The project innovatively uses geospatial technology and data analysis as instructional tools to assist science learning (Hunter and Xie, 2001). VISIT conducted seven types of activities during the grant period. These included organizational development, development of investigations and learning materials, recruiting, workshops, online Collaboratory development and operations, formative evaluation, and dissemination/institutionalization. The project covers a wide range of subject areas, including math, environmental science, biology, chemistry, earth science, information technology, social science, geography, and history. The project attracted a large number of participants. Approximately 705 teachers and staff registered in the VISIT Collaboratory during the project's four years. Among them teacher leader/staff accounts are 55 and participating teacher accounts are 650. Among those figures there are 477 active accounts, including 50 active teacher leaders and project staff accounts and 427 active teacher accounts. Moreover, 596 teachers participated in the VISIT workshops during the period from Summer 2000 to Summer 2003. Around 140 teachers attended one-day to five-days GIS basic skill training workshops and summer institutes. Among the workshop attendees, 166 of them registered to VISIT Collaboratory and 27 of them received a sum of 81 EMU graduate credits. Altogether 118 teachers got a total of 330 free graduate credits from the VISIT project. Overall, the VISIT project served more than 1,200 teachers.

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