GEOGRAPHIC INFORMATION SYSTEMS AT UW-PARKSIDE

Geographic Information Systems (GIS) are an increasingly ubiquitous technology in modern society. GIS allows academics, governments, and businesses the ability to map and analyze spatial data, as well as build and manage large spatial databases. **CSSPS is requesting $127,170.00 in one-time support to renovate and expand GIS lab space in Molinaro Hall and to establish a GIS Factory in the Innovation Corridor.**

The Geography Department at UW-Parkside currently offers an 18 credit GIS minor and a 12 credit GIS Certificate. The program draws majors from Geography, Anthropology, Environmental Studies, Biology, Geosciences, History, Economics, and more. The Department proposes two projects to increase student enrollment and success in the field of geospatial applications. The first is to upgrade and expand the existing Spatial Data Analysis Lab. The second is the establishment of a 'GIS Factory' similar and complementary to the APP Factory.

Geographic information system skills are core components of occupations in geography or photogrammetry; they are also cross occupational skills required for other high demand occupation, as demonstrated in Table One.

TABLE ONE. Earnings and Opportunities in GIS related fields in SE Wisconsin and N Illinois (EMSI, 2018)

O*NET Occupation	Median Hourly Earnings*	2017 Jobs*	2018 Jobs*	2017-2018 Change*	2017-2018 Estimated Annual Openings*
Geospatial Information Scientists and Technologists (15-1199.04)	$42.73	13,826	13,995	169	1,084
Mapping Technicians (17-3031.02)	$25.01	1,186	1,198	12	139
Remote Sensing Technicians (19-4099.03)	$23.35	2,529	2,553	24	319
Remote Sensing Scientists and Technologists (19-2099.01)	$42.77	654	650	-4	53
Cartographers and Photogrammetrists (17-1021.00)	$31.23	209	213	4	19
Electrical Drafters (17-3012.02)	$30.54	816	820	4	74
Civil Drafters (17-3011.02)	$26.01	2,551	2,572	21	241
Database Architects (15-1199.06)	$42.73	13,826	13,995	169	1,084
Web Developers (15-1134.00)	$30.15	6,395	6,513	118	565
Bioinformatics Technicians (43-9111.01)	$23.54	409	412	3	53

From Dec 2016 to April 2018, there were 96 unique job postings in the region for Geographic information scientists and Technologists alone. Fifty-two percent of these positions required a bachelor's degree. Fifty-one percent were located in Cook County and 13% in Milwaukee County. Eighty-four percent were in the private sector. (EMSI 2018)

Employment of cartographers and photogrammetrists is projected to grow 19 percent from 2016 to 2026, much faster than the average for all occupations. Job prospects are likely to be excellent due to the increasing use of maps in government planning (U.S. Bureau of Labor Statistics, Employment Projections program).

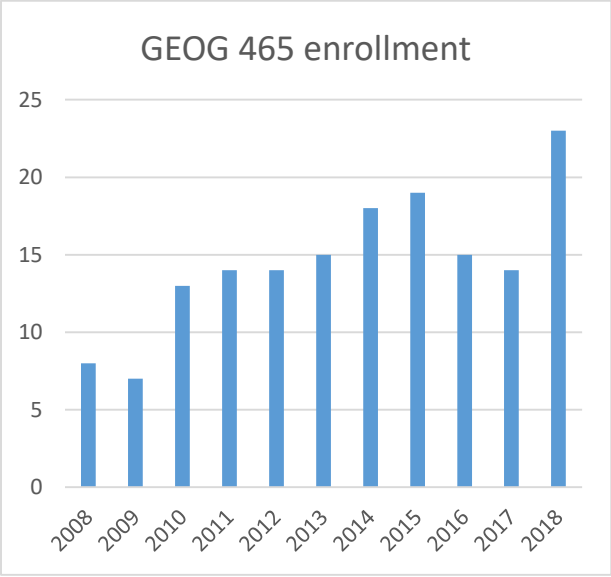
Employees with geographic and geospatial skills are in high demand to help solve real-world problems and enhance organizations' efficiency and effectiveness. The latest estimates from the US Bureau of Labor Statistics classify GIS and remote sensing (RS) as "new and emerging" fields, in part because of their importance to the "green" jobs sectors. Job openings for GIS and RS scientists, technicians, and technologists are projected to grow between three and nine percent between 2010 and 2020, while median salaries for these positions continue to rise. The job category of "geographer" is poised for even more dramatic growth, with job openings projected to increase nearly 30 percent by 2020 (http://www.esri.com/esri-news/arcnews/spring13articles/getting-a-job-in-geography-and-gis).

GIS CERTIFICATE AND CLASS ENROLLMENTS

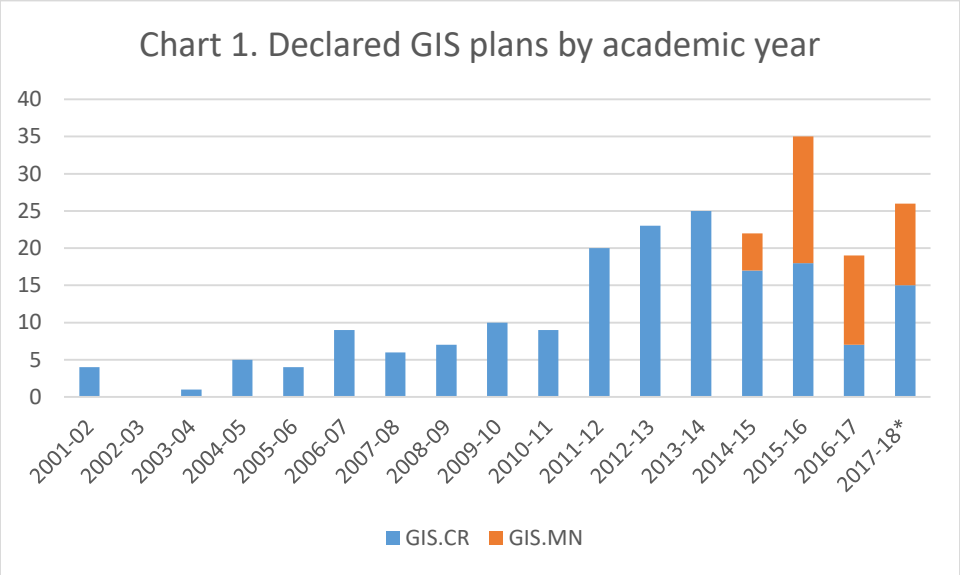
GEOG 465 is a good indicator of number of GIS Certificates awarded as it is the "capstone" class for the program. Note however, a few students have fulfilled this requirement with an Independent Study (GEOG 499) or Internship (GEOG 494) course. T

ADVANCED GIS (GEOG 465)

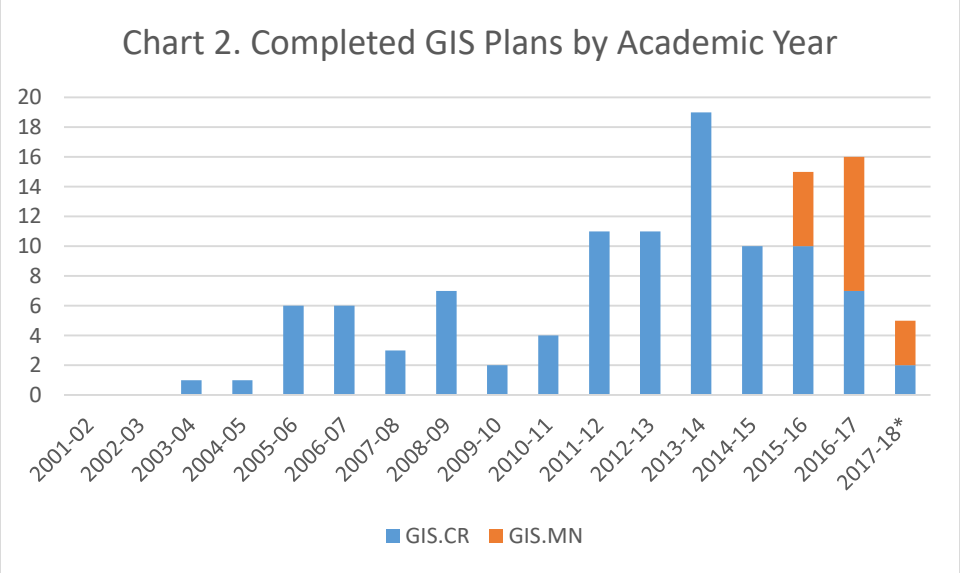
Year	# Students
2008	6
2009	4
2010	7
2011	11
2012	10
2013	18
2014	11
2015	19
2016	15
2017	14
2018	23



The following charts display declared GIS plans (certificates and minors) and completed plans. There is a steady increase overall, yet the rate of increase doubles after 2010-11. Charts 1 and 2 display data separated according to declarations and completions, while Chart 3 presents the two data sets together for easier comparison.

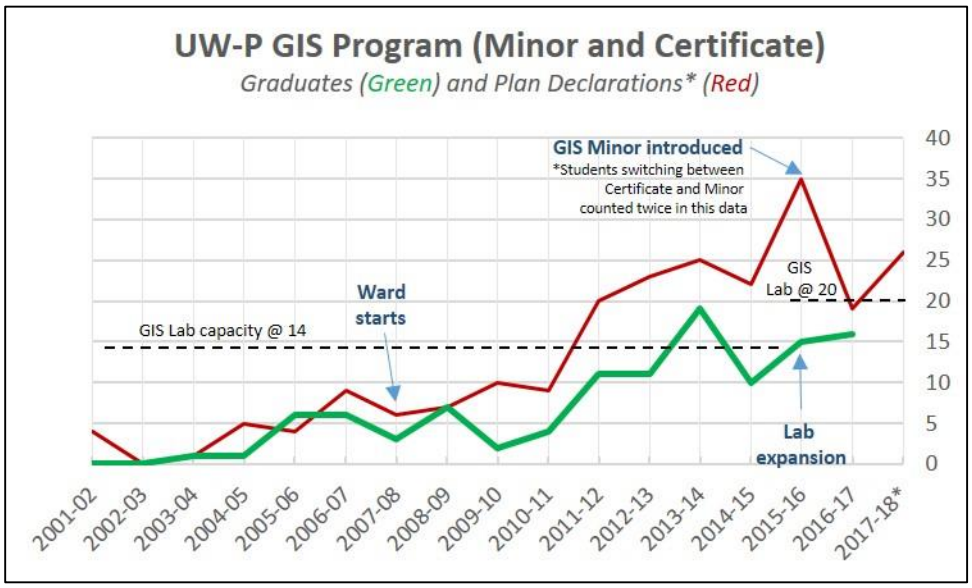


***Through 4/30/2018*



***Fall 2017 only*

Chart 3. Combined graduates and declarations



In conclusion, it is clear that as we expand opportunities for students to study GIS at the Certificate and Minor levels, the number of students increases; there is clearly strong growth in GIS education at UW-Parkside. By developing opportunities for practical applications of GIS, students will be even better prepared for the job market.

GIS FACTORY

The GIS factory has been planned in collaboration with CBEC and the APP factory and will be located in the Innovation Corridor. Dean Baldwin and Zaid Altahat agree that the GIS factory can complement the innovative and entrepreneurial focus of the Innovation Corridor. In fact, the APP factory has employed GIS students in the past year to work on specific computer applications.

The GIS Factory uses the same model as the APP factory- establish an entrepreneurial context for students to work on client-based projects. Students not only practice and improve their GIS skills; they also learn valuable work-related skills such as meeting deadlines, accommodating client needs in efficient and cost savings approaches, and project cost/time estimation. Two levels of student workers are needed – GIS technicians and GIS analysts. GIS technicians perform data entry and cartography while the analysts perform data processing and advanced analysis. Having two levels of GIS employees also serves to educate the students on the difference between entry and more advanced positions.

We anticipate that the GIS factory will become self-sustaining within one year. As an estimate, projects can be small, medium, or large, depending upon the number of hours needed and the type of work required (cartography v analysis).

GIS FACTORY BUDGET		
Item (Everything except student workers)	**Cost**	**Notes**
Computers (2x $1000)	3000	
Printer/paper/ink	200	
GPS units (2x $500)	1000	field data collecting
Desks (2x $200)	400	
Chairs (2x $60)	120	
Marketing (business cards, door signs, etc.)	200	
Director Stipend*	3500	annual
Subtotal (without student workers)	**8420**	
Student Workers*		
GIS Technician ($15/hr student) - "Small Project"	1500	100 hours of work (GIS Technicians perform data entry and cartography)
GIS Technician ($15/hr student) - "Medium Project"	3000	200 hours of work
GIS Technician ($15/hr student) - "Large Project"	7500	500 hrs of work
GIS Analyst ($20/hr student) - "Small Project"	2000	100 hours of work (GIS Analysts perform analysis and/or data processing)
GIS Analyst ($20/hr student) - "Medium Project"	4000	200 hours of work
GIS Analyst ($20/hr student) - "Large Project"	10,000	500 hours of work
Subtotal (for student workers)	1500-15,000	From smallest map making project to large project requiring a technician AND an analyst
TOTAL (supplies and workers)	**9920-23420**	

* All expenses in this table are one-time requests. Director and student compensation will be self-sustaining following this first year.

GIS STUDENT INTERNSHIPS

In recent years the number of students undertaking internships related to GIS has greatly increased, evidence that applied experiences are abundantly available. Organizations include, but are not limited to, the City of Kenosha Engineering Department, Kenosha Water Utility, Racine County Planning, Racine County Health Department, Mt. Rainier National Park, Racine County Economic Development Corporation, River Bend Nature Center, Waukesha County Land Conservancy, WE Energies, Dane County Planning and Development, and General Mitchell International Airport.

In order to both serve clients that might have a limited or non-existent budget, as well as provide more opportunities for GIS Students, the GIS Factory can employ students as interns in addition to the direct "student employee" pay scale outlined in the budget for paying clients. This "sliding scale" approach would have a "low end" in terms of pay by employing a student as a paid intern at the $10/hr rate provided by InternConnections. Thus our existing internship program would not disappear; it would be incorporated into the financial plan with a sliding scale allowance.

The GIS Factory provides potential opportunities for UW-Parkside students in the Masters in Professional Studies Program (especially those who have completed the GIS Minor or GIS Certificate as an undergraduate at UW-P) to gain valuable experience working with local clients on projects related to their interests.

GEOGRAPHY DEPARTMENT SPATIAL DATA ANALYSIS LAB (MOLN 219)

The Geography department at UW-Parkside maintains a Spatial Data Analysis Lab (aka the GIS Lab). At the current time the lab has 20 work stations, two printers, and a utilizes UWP network servers for storage. The computers are 4-5 years old and desperately need to be replaced. In the past, the lab has utilized the flex-client streaming virtual image configuration operated by Campus Technology Services (CTS). This is no longer used in the GIS lab.

The Lab is used by several geography and anthropology courses, including full time use for several GIS classes, and occasional usage by non-GIS classes. More importantly, the geography students use the Lab frequently to work on projects, complete assignments, learn from each other, interact with faculty, etc. Currently, the GIS courses (GEOG 350, 460, 465) are too large for MOLN 219 and the cramped space makes instruction more difficult. Wheelchair accessibility is only possible at one workstation and, if this is used, the main aisle is blocked. Additional work stations are needed to accommodate increasing student demand in these courses.

The expansion of the lab utilizes space that is currently not utilized or underutilized. MOLN 223 is a classroom designated for teacher education that has not been used in five years. MOLN 221 is a space that is the size of a classroom (19x23) that is currently being used as an office for the Geography/Anthropology chair and is far too large for that purpose. The Remodel would increase space by 345 square feet and allow for the addition of 15 computers/work stations, as well as making the entire space more wheelchair accessible. The new configuration would

allow better visibility of the whiteboard/screen, which is currently a barrier to learning in the GIS lab. The addition of portable hard drives for storage will make data more accessible to site visits with clients.

The old lab space will be converted to office space for three faculty in Geography/Anthropology. Close placement to the lab will allow for increased collaboration and research between students and faculty. Facilities has provided a preliminary plan for the remodel. (See attached diagram).

RENOVATION OF ROOMS 219, 221, AND 223

Demo	Remove tile floor from RM's 221 & 223 (price quoted is figuring abatement of asbestos flooring), remove wall between RM's 221 & 223, remove plumbing and cap behind drywall in rooms 221 &223, remove millwork in RM's 221 & 223, remove ceiling grid, tile, and lights from RM's 219, 221, & 223
	Disconnect and remove (24) 2 x 4 florescent fixtures, (4) receptacles, and (3) data boxes
Construction	Provide and install ram-board on the floor of RM 219 to protect existing tile
	Divide RM 219 into (3) separate offices with hallway per sketch provided with 3-5/8 studs,insulation, and (1) layer of 5/8" drywall each side
	Walls to be built to clear ceiling, not to deck above
	Patch walls in RM's 221 & 223 where wall and millwork was removed
	Install 2 steel door frames, plain sliced red oak doors with ½ windows in new offices
	Provide and install new 15/16" ceiling grid and 2 x 2 USG Radar revealed edge tiles in RM's 219, 221, & 223
	Reverse the swing of the doors on RM's 221 &223 to swing into the hallway using the existing doors and adding new locksets
Electrical	Provide and install temporary lighting
	Provide and install (24) new 2 x 2 LED center basket troffer fixtures in RM's 219, 221, &223, (2) new exit fixtures, (1) new 3 way switch, (3) new motion sensor switches, (4) new duplex receptacles, and (1) occupancy sensor in large office
Painting	New walls (1) coat of primer and (2) coats of finish
	Existing walls patch and (2) coats of finish
	Paint new door frames and stain new doors
Flooring	Provide and install new Armstrong Standard Excelon VCT floor tile (color to be selected by UWP) in RM's 221 & 223,
	Provide and install new 4" Johnsonite vinyl base in RM's 219, 221, & 223
HVAC	Provide and install (14) new supply and (5) new return grills (any extension of duct work to be flex)
Alternate	Provide and install new 3rd door with ½ window and frame in north office of RM 219 and infill existing door to hall east entrance

	Paint and stain door, touch up paint on hall side of door being infilled	
TOTAL		70,000.00
Excludes	Permits, cores for locks, new flooring in RM 219, anything pertaining to the fire alarm	10,000.00
	CTS estimate for connectivity (data wiring)	3500.00
Computers, Workstations	15 computers at 1000/computer = 15000 15 workstations at 250/station= 3750	18750.00
Portable hard drives for 4 TB of storage	1 per computer. 15 computers at 100.00 hard drive= 1500.00	1500.00
ESTIMATED TOTAL		103,750

FACULTY QUALIFICATIONS TO MOVE THE GIS TO THE NEXT LEVEL

Currently, four of the six faculty in Geography/Anthropology have extensive experience with GIS in both the private and public sectors, and across various applications. This section highlights the array of skills and research applications that they offer to our students and provide to private and public organizations.

John Ward currently serves as Director of the GIS Factory, the Spatial Data Analysis Lab, and the GIS Minor and Certificate Program. Ward has been exploring the relationship between people and the planet utilizing geospatial technologies since his introduction to Geographic Information Systems (GIS) in 1999. He spent many years working as an archaeologist in the Pacific Northwest. Along the way he traded in his trowel for a computer and began working as a GIS Consultant both independently and for Earth Imaging Associates, Inc. in Ellensburg, WA. He later moved south to do urban planning GIS work for local municipalities near Savannah, GA. His GIS experience has involved working closely with numerous Native American tribes; federal, state, and local government agencies; and private land owners. Currently he is working with the City of Racine and Meadowbrook Country Club

Caitlin L. Curtis is an anthropologist with a focus on cultural heritage studies using methodologies of ethnography and GIS for practical applications in community engagement. In addition to her longstanding archaeological and heritage research in Turkey, she is currently developing community heritage mapping research projects in both Armenia and Greenland.

Her current research focuses on participatory GIS applications. Participatory mapping ensures previously marginalized voices in the community are heard and seen using the impactful analytical and visual power of GIS. She integrates historical and current satellite imagery, municipality maps, and archaeological site plans with perceptions from local participants to analyze change over time in their landscape from their perspective. This same application will be needed as we experience rapid economic development, and its concurrent agricultural displacement in southeastern Wisconsin.

She brings this community-focused GIS approach to the classroom, developing a new course on "GIS and Communities," training students in the anthropological basis of community research and using GIS skills to solve real problems in the Kenosha/Racine community and beyond. For example, Revitalize Racine is currently seeking her class's GIS help in documenting the condition and vacancy of home and business properties, and identifying potentially rehab-able properties. By mapping the city's housing status and needs, they contribute toward increasing the quality of available housing. UWP GIS lab facilities can create future partnerships with community organizations, as well as to develop her international participatory GIS research projects.

Kenny French is an urban geographer conducting research on residential segregation, ethnic enclaves, and the geography of rap. French has utilized GIS techniques to spatially analyze the quality of life characteristics of segregated neighborhoods in Milwaukee, WI. This research involved creating a GIS geodatabase of socioeconomic variables for each Milwaukee Census Tract to link social inequality with spatial inequality. His historical geography research on Italian Americans in Kenosha included geocoding residences and ethnic businesses to identify the Old West Side enclave. He has developed and taught a GIS Applications in Urban Planning course and has remote sensing analysis experience at the Center for Advanced Land Management Information Technologies (CALMIT) in Lincoln, NE. His GIS software knowledge includes ESRI products, the open-sourced QGIS, and the geospatial statistics-driven program of GeoDa.

Joy Wolf is a full professor in the Department as well as the Academic Director of the Sustainable Management consortium program. Dr. Wolf applies GIS to understand patterns in biodiversity, fire history, landscape ecology, wetland/soil dynamics and bird song or migration. Her use of GIS began during her doctoral studies to examine invasive species in a montane grassland in Rocky Mountain National Park, Colorado. Her study sites also include oak savanna and maple-beech forests in Wisconsin, riparian corridors in Arizona, wetlands in Oregon and Wisconsin, old-growth forest in Grand Canyon National Park, and coastal forests in the Pacific Northwest. Her courses include Biogeography, Landscape Ecology, Natural Resources Management, Dendrochronology, Soil Ecosystems, Field Methods, Physical Geography, and Applied Research for Professionals.

In addition, other faculty in the department have overseen student projects using GIS to examine topics such as the location of the disappeared Pike Creek in the city of Kenosha and location of effigy and burial mounds in SE Wisconsin. In short, the entire department provides a supportive environment for students to apply GIS skills to a range of problems. This will greatly benefit the GIS Factory by ensuring that we have faculty and students to work on projects.

BENEFITS TO THE STUDENTS, THE UNIVERSITY, AND THE COMMUNITY

With four members of the department skilled in GIS, and the inclusion of anthropology into the department, this unit is poised to take advantage of the economic development in the region.

The first, and primary, beneficiaries of the GIS factory are the students. In addition to valuable work experience, students benefit from the ability to participate in learning environment which not only provides academic support and guidance, but also offers flexibility and ease of scheduling. These would nearly impossible in an internship that would be exclusively offsite. And, they will be paid while they are doing it.

Extrapolating the rate of increase in the last five years using data from Chart 1, and conservatively assuming demand will at least remain the same, we estimate a 75% increase in GIS students within two years. Interns in the GIS Factory will vary depending upon projects, and these interns can be students from across campus, as GIS is used by a number of disciplines, especially in computer and the natural sciences. We have anecdotal evidence of successful student employment after internships; the relationships and applied experiences for our students will result in a significant increase in the percentage of students who find employment in their major, but also will decrease the time between graduate and employment.

The Geography department is already contributing to our Master of Arts in applied Professional Studies. A planned graduate certificate in smart city management will require a larger role for applied GIS. Expansion of the GIS labs and the accompanying internship program in the GIS factory opens up the possibility of an MS in GIS.

Locating and operating the GIS Factory in the Innovation Corridor will complement the client-focused opportunities that already exist through the SBDC and the APP factory. It is a logical addition to the units already in the corridor.

As mentioned above, GIS is in high demand and, with the development accompanying the Foxconn project, will only be increasing in southeastern Wisconsin in the coming years. *A* growing number of cities are seeing Geographical Information Systems (GIS) as a key that can unlock powerful insights that would otherwise be hidden in data. Comparing the cost of our projects to current salaries in the region (see Table 1), we offer an affordable and quality option to our local public and private partners. In the last three months alone, we have been approached to work on public and private projects both Kenosha and Racine. Since we are operating on a cost recovery basis, we intend to establish a sliding scale cost, which will support nonprofits in the area as well as campus research.