A Proposal to Create a
Grand Challenge Scholars Program
at Michigan Technological University

Submitted by:
The College of Engineering
and
The Pavlis Honors College

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Dr. Wayne Pennington
Dean, College of Engineering

Dr. Leonard Böhmann
GCSP co-Director
Associate Dean, College of Engineering
ljbohman@mtu.edu
(906) 487-2005

Mary Raber
GCSP co-Director
Assistant Dean, Pavlis Honors College
mraber@mtu.edu
(906) 487-4318
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1. Vision and Goals
Michigan Technological University is pleased to submit this proposal to establish a National Academy of Engineering Grand Challenge Scholars Program. Michigan Tech has a long history of integrating opportunities for hands-on experiential learning for its students to supplement their areas of study. From highly distinctive programs such as Enterprise (www.mtu.edu/enterprise), the Global Leadership program (www.mtu.edu/honors/learning-community/global-leadership/), and the new Pavlis Honors College (www.mtu.edu/honors), Michigan Tech actively encourages students to take advantage of a vast array of available learning experiences to enhance their traditional education.

The objectives of the NAE Grand Challenge Scholars Program align very well with Michigan Tech's educational objectives and our desire to encourage students to apply these experiential opportunities toward the development of innovative solutions to the challenges and needs our world is facing. We believe that today's graduates need more than just a degree in their discipline of choice. In order to address today's challenges, our graduates need to have a well-developed sense of the cultural, political, social, ethical and economic contexts in which they will be working.

We propose to support the achievement of these shared objectives by providing a structured pathway through our Pavlis Honors College. Established in 2014, our Pavlis Honors College (PHC) was created through the vision and financial support of Frank Pavlis who retired from a highly successful 40-year career at Air Products and Chemicals Inc. Mr. Pavlis believes that students should be encouraged to develop an innovative and visionary entrepreneurial spirit, communication and people skills, and a broad systems perspective that includes not only technical breadth and awareness, but also the global business sense to create a sustainable, quality future. It was the vision of Mr. Pavlis that led to the creation of the Pavlis Institute for Global Technological Leadership in 2005, one of several high impact programs at the university which led to the creation of the Pavlis Honors College.

Utilizing the existing framework of the PHC will allow us to create an interdisciplinary home for GCSP to engage students from all academic units, and encourage them to work together across disciplines and develop innovative solutions to the 21st century challenges in a holistic way. We envision a program that facilitates the development of skills, mindsets and behaviors needed to address complex problems...one that prepares students to create the future.

2. GCSP Components
2.1 Educational Framework
Michigan Tech's Pavlis Honors College is redefining honors education because we believe that a student's potential and future success are determined by more than their GPA. The mission of the college is to support highly motivated Michigan Tech students from all majors and regardless of their GPA, and inspire them to lead, create, and travel their own path with the personal and professional tools needed to collaborate, learn and reflect.
With this support, students become the next generation of scholars and leaders who make a difference. The college serves undergraduate students University-wide by providing an academic home for engaging educational programs in leadership, innovation, research, and service.

Students that apply and are accepted into the honors college choose to fulfill the required components of the program in one of six learning communities or pathways: Research, Industry, Global Leadership, Community Engagement, Innovation & Entrepreneurship, or Custom (available to students who want to construct their own pathway that crosses multiple pathways). The curricular and co-curricular components of the honors program are as outlined in Figure 1.

![Figure 1. Components of the Honors Curriculum](image)

To fulfill the requirements of the honors college, students must complete a series of three 1-credit honors seminar courses which are designed to help students develop self-authorship, personal leadership and cultural awareness.

Students also complete co-curricular components that include: 1) an academic enhancement outside their major such as a minor or certificate; 2) an immersion experience such as a relevant internship or study abroad; 3) an honors project which is designed by the student around a key problem that they would like to address; and 4) a leadership/mentorship project in which the student gives back to the community in a meaningful way.
Because the objectives and structure of our Pavlis Honors College align so closely with those of the GCSP, we believe we can provide a well-structured and supported environment in which students can focus their academic enhancement, projects and immersion experience toward the development of sustainable, robust solutions that help to address the Grand Challenge theme areas. We envision a subset of our honors students will elect to build their honors pathway around one of the grand challenges, and will thereby define their academic enhancement, immersion, and projects in a way that appropriately focuses on one of the grand challenge theme areas and fulfills the five competencies of the GCSP, namely research, interdisciplinary, entrepreneurship, global, and service learning. The following section provides examples of how a typical PHC student can align their honors requirements with the five components of the GCSP program.

2.2 Program Components
Meet Nichole, an undergraduate student majoring in software engineering who is also pursuing the PHC global leadership pathway. Joining the program in her first year, she completed a series of interdisciplinary courses in topics such as leadership, human centered design, cultural awareness, and lean start-up, earning an 18-credit Leadership Minor. To fulfill the requirements of the global leadership pathway, she completed a global immersion experience which consists of a 5-week student-led international experience in India, one of our international project sites. During the two years leading up to the international immersion, Nichole worked with her international travel team to identify a service learning project for a rural community in India. Through communication with the partner organization, her team determined that a primary school in the partner community would benefit from a clean water source. Nichole and her team conducted extensive research and developed a design for an innovative water filtration system. While in India, they worked with the partner community to implement their project, thus providing clean water using a biochar filtration system. While at Michigan Tech, Nichole also completed training through the Stanford design school’s University Innovation Fellows program and is helping to build a culture of innovation & entrepreneurship through student facilitated design thinking workshops. Nichole also attended the Grand Challenges Summit in Beijing China and is looking forward to becoming a GSCP ambassador, helping to raise awareness for Michigan Tech’s GCSP program. Finally, Nichole also serves as president of the student led Innovation Global Solutions Enterprise team, helping lead her enterprise in the development of sustainable solutions for developing communities.

Nichole is just one example of how PHC students have designed their honors experience in a way that would clearly also meet most, if not all, the requirements of the GCSP program. In general, honors students who elect to also participate in GCSP will need to design their pathway in a way that clearly incorporates the five required components. Students will develop a GCSP “contract” and submit it to the steering committee for approval. Students will articulate their plan to address each of the GCSP components through the four required elements of the Honors program outlined below:
1. Academic Enhancement – students must identify a minimum of 8 credits of upper-level coursework, outside of their major area of study, that aligns with their personal, professional and GCSP goals. Most students elect to complete a minor or certificate program that compliments their major and closely relates to their honors pathway. A wide variety of curricular options exist for students to choose from, including interdisciplinary minors, dual majors, accelerated masters, pre-professional programs, and certification programs.

2. Immersion Experience – students must identify an experience of 50 hours or more during which they can immerse themselves in a related field in order to gain practical experience in context. This can be accomplished through internships, co-ops, study abroad, or on-campus opportunities such as the Enterprise Program. Students must also complete a series of written reflections throughout their immersion in order to clarify key insights and learnings from the experience.

3. Honors Project – for this requirement, students must identify and complete a distinct project of their creation and informed by a faculty mentor who brings significant experience and acts as a resource in the completion of the project. Project mentors should be individuals who can share their expertise in an area related to their project, or can serve as a stakeholder who shares important perspectives related to the project. The project must be a distinct work that advances an idea in original way, spans 50 hours or more of work time, and results in a product or deliverable such as a device, process, event, organization, or system.

4. Leadership/Mentorship – this is the student’s opportunity to put their experience into action through a minimum of 15 hours of leadership or mentorship as exercised in a culminating project. Students must articulate how this experience will align with their values and goals and addresses a critical community need. Students also complete a series of written reflections throughout this experience.

Ultimately, students of the GCSP will complete a 2-3 year curriculum that encompasses the honors seminar series together with the curricular and co-curricular components as shown in Figure 1. The program utilizes a combination of classroom and experiential learning that challenges students to assess their own skills and behaviors, develop their leadership ability and cultural awareness, bolster self-confidence and tackle problems as a team that will positively impact people at home and around the globe. Past projects that have been developed and implemented by honors students that align well with GCSP themes include:

- design and implementation of biochar water filtration systems to provide clean water for schools in rural villages in India
- design and delivery of a mobile health clinic for use in rural communities in Ghana
- design and delivery of hands-on STEM education experiences for K-12 children in Tanzania
- development and test of a low-cost infant heart monitor for use in rural/developing communities

Incorporation of the GCSP components was inherent in the students’ execution of these projects. Students who elect to pursue the GCSP pathway will be encouraged to develop solutions that go well beyond a single site of implementation, but instead seek ways to work together with the communities to develop solutions that bring sustained value and broader impact.

To become a candidate of the Grand Challenge Scholar program, students must first demonstrate how they intend to meet the requirements as articulated by the five program components through an application. The application must identify a plan for each of the Honors program requirements that addresses one of the Grand Challenges or theme areas and also incorporates the five GCSP components: research, interdisciplinarity, entrepreneurship, global dimension and service learning. Finally, students (with the help of honors college advisors) will identify a faculty mentor who will help guide and advise the student. The student, with support from their faculty mentor, will report progress to the steering committee on a periodic basis as appropriate to the timeline of the proposal.

To earn the distinction of Grand Challenge Scholar, students will submit a final report which will demonstrate the student’s achievement of the required curricular & co-curricular elements, key learning outcomes, and successful incorporation of the five key components, including:

✓ a description of their research
✓ a summary and reflection of interdisciplinary work as achieved through courses, project work, or research
✓ a reflection of the global perspectives achieved through project related activities such as a study abroad, or work on a globally significant project
✓ a narrative describing the relevant entrepreneurial initiative, application of innovation and design thinking, and/or demonstration of entrepreneurial mindset, to be accomplished through activities such as participation in a startup competition, creation of a new venture, or incorporation of the design thinking or lean startup methodologies
✓ a reflection of their community engagement experience and how it impacted their perspective on empathy and compassion for intended recipients of their design solutions

In addition, students will present the results of their work at an appropriate forum such as our annual design expo or D80 conference. Finally, students will document their work through the creation of a portfolio on that platform used by the honors college, seelio.com.

Numerous opportunities exist for students to incorporate the GCSP components into their honors pathway, examples of which are identified below:
Research – Michigan Tech offers a wide variety of undergraduate research opportunities including an Undergraduate Research Internship program, the Michigan Space Grant Consortium, and the Summer Undergraduate Research Fellowship. Outside of these structured programs which are managed by the PHC, we also help to connect students with research faculty who offer opportunities for students to contribute to projects in their labs as well as external research opportunities at other institutions.

Interdisciplinary Component – This would likely be fulfilled by the PHC Academic Enhancement which requires a minimum of 8 semester credits outside the students’ major. Students typically fulfill this through a minor or certificate, or a series of at least three courses that complement their major and relate to the GC challenge they would like to address. Michigan Tech offers numerous minors and certificates from which students can choose. Students could also identify an external certification program that aligns with their chosen GC challenge or theme area.

Entrepreneurship – As Michigan Tech works to build a culture of Innovation & Entrepreneurship we are adding increased support and more opportunities for students to engage in their I&E interests. Over the past two years we have added a new 4000 sq ft student-led makerspace, the ICE House (a student residential option for budding entrepreneurs), and a new Innovation Center for Entrepreneurship (ICE) to provide training and support for I&E initiatives. On the academic side, we have added new courses in design-thinking, lean start-up and social innovation and are in the process of developing a Minor in Innovation & Entrepreneurship. We also facilitate student participation in numerous pitch and design competitions at the local, state and regional levels. With this growing list of opportunities, GCSP candidates will have a multitude of options to fulfill the entrepreneurship component.

Global – Students at Michigan Tech are strongly encouraged to explore and pursue opportunities for global engagement. From traditional study abroad options, to unique faculty-led study abroad programs and our highly distinctive global leadership pathway within the Pavlis Honors College, GCSP candidates will have many exciting options to choose from in order to fulfill the global component. The GCSP program will offer students the opportunity to go beyond study abroad coursework to engage in a meaningful and purposeful way with the community through the incorporation of a STEM- and/or service learning-focused project. Academic options include minors in International Language, International Business, and Global Leadership.

Service Learning – Michigan Tech is placing increased attention on service learning and is in the process of developing a center for community engagement that will facilitate student learning and experience through service projects, domestically and abroad. This new center will allow us to provide a more focused effort toward engaging students in civic and socially conscious initiatives. In
addition, there are numerous existing service-learning opportunities with a long history of student engagement including student organizations like Engineering World Health and Engineers without Borders, Alternative Spring Break trips, and annual community service events. Students may also elect to pursue a minor in Community Engagement.

2.3 Unique Aspects Of Michigan Tech’s GCSP Program
The proposed GCSP pathway would be an integral part of the existing Pavlis Honors College which provides all undergraduate students with the opportunity to engage in interdisciplinary, experiential learning. All students who complete the requirements of the GCS program will, by design, also fulfill the requirements of the Honors College. Michigan Tech’s Honors program is unique in that it strives to support the passions and goals of all students, not just those with a high GPA. The design of our Honors program is based on the belief that success is measured by more than a student’s GPA and we are redefining honors education to focus instead on students’ intrinsic motivation to enhance their learning through co- and/or extra-curricular experiences.

3. Program Administration
3.1 Steering Committee
The Michigan Tech GCSP Steering Committee will consist of a team of faculty, staff and students who are passionate about creating and participating in learning opportunities that support the GCSP mission. Initial steering committee members will include the Associate Dean of Engineering (co-Director GCSP), the Assistant Dean of the Pavlis Honors College (co-Director GCSP), selected faculty mentors (ideally 1-2 from each college), and a minimum of two students who are pursuing an honors pathway. We believe that incorporating the voice of the student into the oversight of the program is essential to meeting the needs of the students as well as those of the GCS program. The student members will not be responsible for assessing the work of GCSP students, but will ideally help to provide peer mentorship and input to the curriculum. Committee members will serve for 2-3 year terms, with staggered terms to ensure continuity of membership. The committee will be responsible for the following:

✓ review and evaluation of student GCSP applications for program acceptance
✓ guiding the curricular structure of the program including identification of project opportunities
✓ interacting with faculty mentors to monitor student progress
✓ documentation of program requirements
✓ providing infrastructure needed to support students project efforts
✓ quality assurance and ongoing assessment of the program as it relates to achievement of GCSP objectives

The Steering Committee will ultimately be responsible for reviewing/approving applications to the Michigan Tech GCSP program, as well as the granting of Grand Challenge Scholar status on the student, certifying that the student has met all stated requirements of the program. Input from the student’s faculty mentor/advisor would be incorporated in the certification evaluation process.
3.2 Recruiting
A key advantage to integrating the GCSP into our honors program is that a well-structured process for recruiting and admitting students into our honors learning community pathways is already in place. With few changes to our existing resources, we can utilize the recruiting, application and selection framework that is already in place. Once a student is accepted to one of our honors learning communities, that they can further apply to become a candidate to the GCSP. Applications will typically be accepted during the fall and spring semester of the students' first- or second-year on campus, although students can apply and join the program as late as the beginning of their third year. Our typical process is to advertise to all first- through third-year students through a variety of marketing efforts including social media, information sessions and mailings. We seek to admit a wide-range of disciplines, backgrounds and interests, and we anticipate that at steady state we will enroll approximately 200 students per year into the college.
Historically, the program has been quite diverse, with a diverse balance of approximately 50% female and 15% underrepresented minorities, more than twice that of the university overall for both categories. The breakdown of represented disciplines has been 67% engineering & technology, 27% sciences and arts, and 6% business.

Once admitted to the Pavlis Honors College, students will be given the opportunity to self-select into the GCSP by completing an additional application process in which students will articulate how they will be directing the required curricular and co-curricular efforts toward projects and experiences that align with the Grand Challenge theme areas and program requirements.

3.3 Application & Selection
We propose to utilize the process already in place for the honors college to support application and selection of students who wish to fulfill the honors program requirements as a candidate to the Grand Challenge Scholars program. The application process for the college requires that students complete several components including: a creative expression of their passions and reasons for wanting to participate in the program (this can be accomplished through a brief video, presentation, essay, an original artwork or some other artifact of expression), an essay responding to a question/prompt identified by the college, and a recommendation from an academic or professional contact. GPA is not a consideration for acceptance to the honors college (other than being in good academic standing) and therefore will not be one for the GSCP program. We believe all motivated students should have the opportunity to pursue their passions.

Students will enter Pavlis Honors College and select their preferred pathway in their second or third year, and will then have the option of choosing to pursue the GCSP certificate which will require an additional application step in which students will declare their intention to pursue the GCSP requirements and present a plan for how they will develop their honors curriculum around a Grand Challenge theme area and fulfill the additional requirements of the GCS program. We anticipate that out of the approximately
200 new students admitted each year, that as many as 10% (20) will choose to pursue the GCSP path.

Upon approval of a GCSP-themed honors pathway, students would then be designated as a Pavlis/GCSP scholar candidate. Students would spend their remaining semesters completing the requirements of the program around their chosen theme area.

3.4 Faculty Mentors
PHC faculty/staff advisors are already in place for each of honors pathways which will provide the needed structure to also support GSCP students. These advisors will meet with students periodically during their time in the GCSP program and guide them through the process of developing and implementing their plans by providing advice, guidance, connections to relevant resources and evaluation/feedback.

In addition, as each student identifies the required immersion and project work, they will also identify a faculty mentor who will help to guide them in the conduct and completion of their stated “contract”. PHC advisors will assist students in the selection of an appropriate faculty mentor who should be an individual who can share their expertise in an area related to the student’s project work, or can serve as a stakeholder who shares important perspectives related to their project.

3.5 Funding/Support
The quality and sustainability of the GCSP program is of key importance to the university, as is the case for all of our experiential learning programs. The Pavlis Honors College was developed and continues to be supported through a gift from the founding donor, Mr. Frank Pavlis. This funding, together with general fund support through the university will support the integration of a GCSP pathway into the program. Any new and additional GCSP-specific program costs will be supported jointly by the College of Engineering and the Pavlis Honors College. For example, the Dean of Engineering has committed to support travel costs associated with attendance of key personnel and students at annual GCSP events and the Pavlis Honors College will support marketing efforts and student participation in related co-curricular activities such as international project travel. The College of Engineering, PHC and the university as a whole offer many funding and scholarship opportunities for students in support of project development, international travel, and participation in events such as pitch/design competitions that will also be accessible to the GCSP candidates.

4. Student Engagement
4.1 Mentorship, Support, Tracking and Assessment
Ongoing mentorship and support is embedded within Honors college learning communities and will be utilized to support students electing to pursue the GCSP designation. These mentor/coaches help students to map out their pathway, define projects, reflect on their experiences and stay on track. In addition, as students identify and develop their GSCP project, they are required to identify a faculty mentor who will guide the technical aspects of their project. Processes are already in place to facilitate this faculty project mentor engagement.
Assessment for the overall program will closely follow processes that are already in place for our existing Pavlis Honors College pathways. Learning goals and objectives have been identified for each component of the program and will be adopted and/or adapted as appropriate to support assessment of the GCS program. Program assessment will utilize appropriate elements of the University’s Learning Goals which can be found here: www.mtu.edu/assessment/program/university-learning-goals/. Project reviews will be held for each GCSP student throughout the execution of their work, including an initial review as plans are developed to ensure that they have adequately incorporated all GCSP components, and again at the conclusion of the project to ensure all components have been satisfactorily addressed. A presentation to the GCSP Steering Committee will also be a required component for assessment.

Students will also be required to maintain a portfolio, documenting their progress through the program, and utilizing our PHC portfolio platform, Seelio. Faculty mentors and advisors will be able to access students’ work through this platform, and track their progress toward the five GCSP components. The Seelio platform offers the ability for students to tag each work posted to key skills or learning outcomes, such that students can apply this process toward identifying when/how each GCSP component was incorporated into their work.

Students will also utilize our online academic course system, Canvas, to document and track progress through the program. We currently utilize this system to monitor progress and completion of key work products (immersion, projects, academic enhancement) in the Pavlis Honors College and can easily adapt the system to also incorporate tracking of the required elements of the GCSP program.

4.2 Recognition
Students who complete the GCSP will graduate with the distinctions of Grand Challenge Scholar as well as an Honors College Scholar/Leader. The Honors GCSP distinction will be signified by receipt of a medallion to be worn at graduation, as well as an indication of their accomplishment on their transcript and diploma. All graduates will be reported to the national GCSP steering committee each year.

5. Conclusion
Michigan Tech’s College of Engineering and Pavlis Honors College are pleased to present this proposal to establish a Grand Challenge Scholars Program for consideration by the National Academy of Engineering. We welcome the opportunity to become part of the NAE Grand Challenge network of colleges and universities and to offer our students this tremendous educational experience. By utilizing our existing honors college frame work we believe we can offer a strong support system to students interested in participating in the GCSP and we look forward to bringing this program to life at our campus.

Thank you for your consideration of this proposal.