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October 1, 2009

TO: Paul M. DeLuca, Jr.
Provost


Paul S Peercy

FROM: Paul S. Peercy
Dean

RE: Madison Initiative for Undergraduates Phase 1 Proposal Submission

Attached you will find the following Phase 1 MIU proposals from the College of Engineering, which I fully support:

③ Nanotechnology Education: Bridging Technology and Society; Wendy Crone, lead author

 Planning a New Approach to Recruitment, Retention and Educational Program Enhancement of Engineering Undergraduates Through an Interdisciplinary, Cross-Cutting Honors Program; Tom Kuech, lead author

Thank you for your consideration of these proposals.

Attachments

Phase I Proposal:

Planning a new approach to recruitment, retention and educational program enhancement of engineering undergraduates through a interdisciplinary, cross-cutting honors program

Submitted by the College of Engineering: Thomas F. Kuech, Department of Chemical and Biological Engineering (lead), Susan E. Babcock, Department of Materials Science and Engineering, Christopher DeMarco, Department of Electrical and Computer Engineering, Donald Woolston, Assistant Dean, College of Engineering

Proposal Statement: We request MIU funding to prepare a comprehensive plan for a cross-cutting honors program that is centered in the college of engineering and allied to existing university honors programs. If funded, we will gather and evaluate national best practices, development cross campus connections, and use this knowledge to formulate a comprehensive plan for a new type of honors program. This plan will highlight the program goals; structure; benefits to the campus, college and students; resource requirements; and assessment plans. The proposed activity directly addresses the MIU goals of developing new programs needed to attract and train a new generation of engineering leaders (Goal 2) and identifying best practices and on-campus synergies leading to a new honor curriculum (Goal 3).

Problem Statement: The College of Engineering (COE) needs to attract, retain, and educate more creative and industrious students to meet the broad demands of the state's diverse industries. The UW-Madison is a unique environment within the state system due to the large research mission and the wide variety of disciplines represented on campus. Increasingly, the best and brightest women and men are seeking an engineering education experience that is both technically deep and also addresses the broader spectrum of the issues inherent in 21st century engineering problems. A 'different' experience often is offered to aggressive students at our peer institutions via an honors program or track. At present, COE does not have an engineering-centered college honors program. Anecdotal evidence, for example discussions with prospective students, suggest that its lacking limits recruitment and retention of the very students the state needs to educate for engineering careers. This proposal is directed at formulating a new and bold engineering honors program that will distinguish UW-Madison Engineering graduates nationally and internationally as engineering leaders.

Background: The COE has had for many years an honors experience closely tied to the class-based honors program in L&S. The '*Engineering Honors in Liberal Arts*' program allows COE students who are academically distinguished to enroll in honors designated courses in L&S (<http://studentservices.engr.wisc.edu/classes/ehla.html>) and receive an honors (*EHLA*) designation on their degrees. The students must complete 24 credits of honors work over a certain distribution of social sciences, humanities and sciences. The individual departments additionally offer '*Engineering Honors in Research*' which recognize students participating in a sustained research experience. By and large these programs are under development and not well advertised. They also are department centric. These programs meet the expectations of a subset of our students and are valuable. However, they do not address, head-on in an educational environment, many of the issues that engineering leaders most certainly will grapple with early

on and throughout their careers. For example, they lack dedicated and integrated interdisciplinary experiences, both in the underlying sciences and in the departmental programs. They also fail to capitalize on opportunities to integrate research, engineering practice, and classroom experience explicitly in an educational program, and therefore to capitalize on the UW-CoE research environment that is such a fertile ground for engineering education. Explicit inclusion of the complexities of interdisciplinary problem solving, deep technical ability, and broader awareness in an educational program aimed at challenging the most diligent students holds the promise of producing graduates who excel at critical thinking, and can explore ways of knowing, and have the tools to tackle both the technical challenges and societal implications of technological solutions.

It has been recognized in reports and programs by the National Science Foundation, the National Academy of Engineering (*The Engineer of 2020: Visions of Engineering in the New Century, Educating the Engineer of 2020: Adapting Engineering Education to the New Century*), and other professional society reports that a new paradigm is needed for the education of engineering leaders. The next generations of engineering leaders need to have a broader base of knowledge, broader adaptability, knowledge of team-based approaches to problem solving, and a societal context for their engineering approaches. In response to these recognized challenges, the COE 2010 Task Force formed in 2005 has undertaken some study and test projects in the use of technology and broader interdisciplinary approaches amongst the engineering curricula as well as broadening the opportunities for service-based learning. Absent from these efforts is a directed, interdisciplinary experience serving the highest achieving engineering students.

The recent report entitled, *University of Wisconsin Honors Programs: An Assessment of the Undergraduate Experience (June 2009)*, provides the most recent view of the honor students' expectations and experiences in the programs within the various colleges. While honors students have some common expectation of challenges and motivations, the COE students are distinguished in this report from those in CALS and L&S. All these programs attract academically and demographically distinct students. The general student expectation is towards a challenging academic environment, however the nature of the challenge and the mechanism is not well articulated by the students as they enter these programs. The students' approach to the respective honors program is largely shaped, therefore, by the structural aspects of the specific program. The student motivations also differ by college. This report finds that in contrast to the students enrolled in the CALS-based honors program, fewer engineering students were motivated to participate in honors programs due to perceived 'perks and ... the program's potential to be a stepping stone to graduate school'. Engineering students were 'most motivated ... by their desire to continue their record of excellence begun in high school'. Among the COE honor alumni, a research experience and close faculty relationships are cited as primary benefits of the current programs. Engineering students also differ in the structural environment of their professional degree. The engineering curricula in its individual fields are more rigid and clearly defined due to the professional requirements of the engineering fields.

A more local review of the COE and the development of new curriculum was carried out by Prof. Pat Farrell, previous UW provost and now provost at Lehigh University. His study which was finished last Spring entitled, "*What's Next in Engineering Education?*" has also identified a COE-based honors as a means to develop and embrace the engineering 'outlier' students. The perceived rigidity in the engineering curriculum is one element that prospective engineering students mention as they are choosing something other than engineering. New

outlets, flexibility, and approaches are needed to address these perceptions and to attract the highly motivated students.

The current honors-based programs in COE, while serving a small number of students to their satisfaction, do not address the challenges outlined and recognized as critical for a forefront program in engineering. The current '*Engineering Honors in Liberal Arts*' program, while most students would recommend the program to others (86%), is regarded as neutral in the honor student's environment and not perceived as having a direct career advantage. A common disappointment of students and alumni of all the university honors programs is the lack of a 'honors' community wherein student of like motivation and drive can be engaged, learn and develop as a group. The research environment at the COE and the rich university educational opportunities are not intergraded into a single learning environment and community for these students.

Other competing institutions have developed more comprehensive honors programs for their students and we have much to learn from their experiences. University of Southern California Viterbi School of Engineering attracts students to their engineering honors program by highlighting specific honors courses, undergraduate honors retreats and specialized advising. The University of Colorado Engineering Honors program emphasizes communities of students seeking a common environment of an accelerated and broadened engineering experience. Purdue, a direct competitor for our undergraduate students, offers specialized advising starting in the freshman year, travel opportunities, an engineering honors community including a separate dormitory community, and priority scheduling and classes. At Ohio State University, first-year engineering honors students have the option to participate in a rigorous first-year curriculum which covers computer-aided design and programming, hands-on labs, written and oral reports, culminating in a robot design or "lab on a chip" project. These schools have identified and recruited these highly motivated students many of which are Wisconsin residents who are choosing the greater financial expense for a richer educational opportunity.

The State of Wisconsin economy benefits from and requires new engineers and engineering leaders. Despite the recession, current demand for engineers is high (WI State Journal, Jan. 11, 2009) spurring expansion of other system schools in the state, most notably UW-Milwaukee. Not all system engineering colleges can provide the type of environment which can compete for the Wisconsin high school students desiring an expanded experience. UW-Madison has a unique role in developing the Wisconsin engineering workforce as the flagship campus with a strong research background and academic diversity. There is a fertile environment in Madison for creating a community to attract and train the next generation of engineering leaders. We hope to distinguish the campus through an innovative program encompassing curriculum and environment.

Program Concepts and Proposal Plan: This working group seeks to develop through this planning grant a program to be presented to the COE leadership in time for active planning in the fall semester of 2010. We will investigate and integrate existing honors programs and practices over the UW-Madison campus into our program plans. The next academic year and summer will be used to visit key institutions to understand the structure and resource issues associated with a comprehensive honors program. Discussions with all stakeholders and past participants of the honors programs will be used for formulate a new vision of an honors program responsive to the COE goals and vision of the future engineer.

Possible program elements:

Recruitment: The current practice in the enrollment of COE students into the existing program occurs in spring with the admission of the next freshman class. Students expressing interest, as well as the applications exhibiting a meritorious high school record, are invited to apply to the program. Presently, there is a higher representation of women in the existing honors program (2009 report) (32%) than in than in the COE (19%) as a whole (https://admin.engr.wisc.edu/student_info/index.php). The students were nearly 88% white by race in the current honors program (2009 report, self-reported) compared to ~7% targeted minority students in COE. These latter numbers are difficult to interpret without more information. These data may indicate that an engineering honors program can serve to attract women and, potentially, underrepresented groups to the COE. We can build upon this record. We plan to use this honors program to aggressively recruit such students and further the goals of diversity within the college and campus. We hope this program could serve as part of the campus effort on 'inclusive excellence' and would align with and serve those efforts.

Learning communities and cohorts: A key finding in the 2009 report on honors programs is the desire for and the lack of honors-based learning communities. An innovation in the proposed honors program would be the formation of cross-field engineering learning cohorts in the freshman year of honors students drawn from all the engineering disciplines, and eventually incorporating students from outside the college from complementary areas on campus. This group of students would follow through the engineering degree process as a group through their UW career. We envision utilizing and partnering the existing programs on campus once the foundation of the COE program is developed. We would hope that joint programs could be more easily developed if our program is planned with knowledge of the structure of the existing campus programs and the identification of the campus-wide synergies and interested people.

Mentorship: These collaborative learning cohorts have been shown to need structure and sustained guidance. Students, particularly freshman, can lose focus, motivation, momentum without trained faculty guidance and mentorship. We would propose a sustained set of faculty mentors be committed to each cohort and participate in the life and development of the group through their four years within the COE. The sustained access to a concerned and knowledgeable faculty member(s) was highlighted as key to the honors experience and intellectual development and is often highlighted by other institutions in describing their honors programs. We believe such faculty involvement is as enriching to the faculty members as to the students, helping to ground the faculty member's educational mission and connect more directly to their research activities.

Curriculum: The honors program should attract those students who would most easily excel within their respective academic fields in the existing curriculum. A possible and hoped for outcome of an academic honors program would be to expand and develop new approaches to teaching by allowing such students greater freedom in the curriculum while still meeting the requirements of a professional accredited degree. Flexibility among the core courses, building on common ground between the engineering disciplines, would allow the cohort to develop in an interdisciplinary mode, drawing from the instructional elements across the campus before entering field-specific courses. We would also like to develop connections between the COE program and those programs outside the COE. We would propose that the faculty mentor and cohort develop a set of liberal arts courses, fulfilling their COE degree requirements, which expand on themes of ways of knowing, societal and ethical impact of technological decisions,

and global awareness. There are courses available, such as ILS153: *Ways of Knowing in the Sciences*, which could be taken by the cohort *and* the mentor in order to develop a discussion of the importance and contribution of alternative views and disciplines, specially the humanities and social sciences. We would use the planning period to work with the humanities and social science faculties to identify such a group of courses.

Research and Project Opportunities: Both the 2009 report on the various campus-wide honors programs and the feedback from students have identified early engineering projects and later the development of research projects and senior theses as key elements enriching the students' experience. The close working relationship between faculty and graduate student mentors over an extended period allows the critical thinking and approaches to scientific and engineering questions to be developed and explored. We would like to develop team-based projects which could span and involve cohort students from across the engineering disciplines. We have some experience in the development of community-based projects, such as those solicited for *INTEREGR 160 - Introduction to Engineering* and through UW-COE chapter of *Engineers without Borders*. As our experience grows, the inclusion of non-COE students involved in the social, political, or economic issues associated with the formation of an engineering solution would be highly desirable. The strength of the Madison campus relative to other system engineering colleges is a highly visible and engaging research program. The strong coupling of the honors program to the research endeavor would help to engage a wider spectrum of the faculty and serve to further distinguish the UW-Madison engineering experience.

Program Metrics: As part of the planning process, we will develop metrics for evaluation of the program's success at attracting, retaining, and engaging engineering students. We will request funding for a postdoctoral fellow or an intern from the UW DELTA program to work with the committee members, drawing on existing practices, to provide an initial means to evaluate the program should it move forward. The ability to attract targeted students and their performance and participation in academic challenges, such as undergraduate research forums and publications, could form part of the evaluation process. While as faculty members we are trained to evaluate students within a classroom environment, we recognize the need for other assessment tools and approaches.

Summary: We are requesting funding to investigate, plan and develop a new comprehensive honors program for the college of engineering. We wish to determine best practices among our peer institutions, develop synergies with the other colleges, and formulate a new innovative honors program. We believe such innovative would recruit and retain a diverse student body, distinguish the Madison COE campus as a leader in academic innovation and foster new interactions between the departments and colleges.

Budget: We request funding for the following:

1. Faculty time for travel and program development (2 weeks over summer per participant):

Thomas F. Kuech	\$9757
Susan E. Babcock	\$6292
Christopher DeMarco	\$7117
<u>Donald Woolston</u>	<u>\$4665</u>
	\$27,831

A postdoctoral fellow is requested to gather data, develop metrics, and assist in the report generation. We will seek an intern from the DELTA program as an alternative.

2. Postdoctoral Fellow \$42000

3. Fringe (Faculty-38.50%,Research Associates 26.50%) \$24845

This is not required if the funding is developed from appropriate campus funds.

Travel Expenses are requested to visit 3-4 places by the proposal team

4. Travel (estimated not confirmed until plans are made)	
Airfare (4 people x 4 trips x \$500)	\$8000
Hotel (4 people x 4 trips x \$100)	\$1600
<u>Meals and incidentals (4 people x 4 trips x \$60)</u>	<u>\$ 960</u>
	\$10560

5. Total \$105236