



TUEE Collaboratory

*Transforming Undergraduate Education
in Engineering (TUEE)*

TUEE Regional Collaboratory Lead University (the campus) College of Engineering

Student-Centered Professional Practice Learning in Engineering (SCPPL-E)

April 10, 2019

The emerging national movement to transform undergraduate education in engineering (TUEE) requires a radical shift from passive learning, four years of classroom lectures and traditional job fairs, to student-centered, pro-active, multidisciplinary learning typified by team-based, open-ended problem solving and project learning involving real-world situations, often with real customers and real potential employers, throughout the undergraduate experience. All access, diversity and inclusion issues must be addressed systematically as well and embedded from the outset. **The TUEE Collaboratory invites the Lead University, College of Engineering (The Campus) to immediately begin creating and implementing a scalable, comprehensive pilot for an innovative systemic model of higher education/industry collaboration that will facilitate widespread implementation of the NSF-supported five-year American Society for Engineering Education Transforming Undergraduate Education in Engineering [ASEE TUEE](#) study findings and recommendations released in 2018.**

Curricular changes, including ASEE TUEE findings and recommendations, dominate the many transformation initiatives currently underway at universities nationally. However, the TUEE Collaboratory model integrates Curricular, Co-curricular (especially professional “soft skills” development), Diversity/Inclusion and new standards for Higher Education/Industry partnering into a comprehensive systemic model of student-centered active learning involving essential engineering professional practice skill sets required to succeed in the ever-changing professional workplace. **The TUEE Collaboratory model with its flexible framework is designed to enable any ABET accredited computer science/engineering program to become a best practice model in the emerging national movement to transform undergraduate education in engineering.**

A select group of small companies would be invited by The Campus to immediately partner in creating and implementing student-centered active learning environments throughout the balance of the 2018-19 academic year and throughout academic year 2019-20 while establishing new partnering standards for higher education/industry collaboration. Students will be empowered to engage in proactive curricular and co-curricular learning experiences to acquire the attributes and skill sets to succeed in the ever-changing technical workplace. The new partnering relationships will include the extensive involvement of alums and recent retirees (academic and industry) in a variety of roles, ranging from professors of practice to co-curricular low-income student work group coaches and mentors, to complement current faculty and staff who are already working with a full plate.

Goals: Create flexible framework (councils and common element platforms) and develop a comprehensive pilot for a sustainable, replicable and scalable systemic transformation model by August 1, 2019 that will be implemented throughout the 2019-2020 academic year.

The purpose of the Student-Centered Professional Practice Learning in Engineering (SCPPL-E) initiative is to establish Lead University College of Engineering (The Campus) as the lead university for the

proposed TUEE Regional Collaboratory, the first regional TUEE Collaboratory. The Campus would select an initial group of about four founding Strategic Corporate Partners (*followed by another four in 4-6 weeks*) to immediately collaborate with students, faculty and staff to create all elements of the SCPPL-E prior to August 1, 2019. The Campus, in collaboration with its corporate, diversity, professional society, community college and alumni partners, would play a key role in the emerging national movement to *Transform Undergraduate Education in Engineering* (TUEE). Included in the initiative is the development of an exemplar K-16+ Diversity/Transfer Scholars model that supports the ASEE Deans Diversity Pledge recently signed by more than 200 Deans of Engineering nationally.

The flexible framework consisting of four councils (Executive, Faculty Professional Practice, Student Professional Practice and Student Diversity Solutions) establishes a scalable comprehensive pilot that would be created and developed by August 1, 2019, then implemented throughout the 2019-2020 academic year. The immediate objective is to establish the pilot for a replicable, scalable and sustainable exemplar model of engineering practice for the TUEE Collaboratory consistent with the ASEE TUEE_ findings and recommendations released in 2018. The SCPPL-E outcomes of the development phase will include:

- an exemplar Professional Practice Program featuring student centered team-based problem solving and project learning throughout the undergraduate experience including a best practice, **sponsored senior design (capstone) program featuring real world problems that will be solved by student teams for at least eight sponsor/customers, at \$23K per project, throughout the 2019-2020 academic year.** To encourage curricular innovations by each member university, Collaboratory curricular involvement is initially confined to assuring best practice common elements for sponsored signature projects each of the four years to facilitate collaborations among member universities and sponsors. This will enable, for example, three students from The Campus to collaborate with three student team members from another university anywhere on the globe to solve a real capstone problem for a real sponsor/customer anywhere on the globe.
- a unique Student Professional Practice Scholars program that establishes a **cohort of at least 60 diverse multidisciplinary honors students** that engages student teams and work groups in co-curricular student managed personal and professional development activities and events in collaboration with corporate partner employees/alums and recent retirees that complement the academic professional practice projects and programs.
- an exemplar K-16+ Diversity/Transfer Scholars model that will **embed the addressing of diversity and inclusion issues at the core of the pilot model** and when it is scaled,
- a world class Strategic Corporate Partners Initiative (SCPI) that systemically engages corporate partner employees/alums and recent retirees with students, faculty and staff to immediately create all pilot elements of the scalable model. In the process of doing so, **new standards for industry/university partnering** will be established that redefine the relationships among the partners to provide an alternative to traditional university Corporate Partner/Affiliate “Pay to Play” programs that tend to treat corporate partners as donors and sponsors of university-defined programs instead of inviting the group of strategic corporate partners to be active investor/partners in the ongoing development of programs that empower students to solve real world problems for real customers and take ownership and responsibility for their own personal and professional development.

An “**Academic Skunkworks**” type operating environment would be established during the pilot development phase to facilitate collaboration by the constituencies noted below to commence developing, by August 1, 2019, the various aspects of the model throughout the balance of the 2019-2020 academic year. **All currently scheduled courses, student programs and events throughout The Campus should be carried out as planned through June 2020 while the academic skunkworks autonomous**

operating environment is established and the comprehensive pilot is implemented throughout the 2019-2020 academic year.

Undergraduate Professional Practice Program including Industry Sponsored Second-Year and Senior Design (Capstone) Projects - The Faculty Professional Practice Council (FPPC) will be responsible for overseeing the overall undergraduate academic experience for all undergraduate engineering students. Included will be a design spine and at least one signature team-based sponsored project each of the four years with design thinking and entrepreneurial mindset integrated throughout. Various presentations and reports will be embedded with each project to help assure that each student has acquired the oral and written communication skills required in the professional workplace upon graduation. The FPPC initially includes faculty members representing each participating engineering/computer science “product major” (Biomedical Engineering, Computer Science, Electrical Engineering and Mechanical Engineering) and related technical managers from each Strategic Corporate Partner. Each Strategic Corporate Partner will have a seat on the FPPC Industry Leadership Board and participate as an active investor/partner.

The sponsored senior design (capstone) projects will be more like an actual industrial work experience than any other course situation. First, projects involve teams of four or five engineering and/or computer science students that are empowered to solve real open-ended customer-defined problems throughout the 2019-2020 academic year. Although a faculty coach (or coaches) is provided for each team, the students are empowered to solve the problem for their customer. Second, skills of negotiating project plans, creating presentations, adjusting to changing conditions, presenting a mid-project critical design review to client senior management and writing and presenting a final report are experienced and learned. Third, senior design (capstone) corporate partners/sponsors provide a stakeholder liaison(s) who maintains weekly contacts with the team for project planning and execution to ensure the goals are realistic and milestones are met. Thus, the senior design (capstone) experience serves as each student’s “final course and first job,” engineering practice prior to graduating. Corporate sponsors plan to use the results produced by their senior design project team and receive full intellectual property rights to those results.

Student Professional Practice Scholars (SPPS) – The objective of the SPPS program is to further establish The Campus as an exemplar model for enrolling, retaining and graduating engineering students of the highest potential who are prepared to enter and succeed in the professional workplace. The co-curricular preparation includes development of the professional (“soft”) skills required to excel. The students, with the coaching and support of faculty, staff and industry professionals, will create their own experiences by engaging in real world situations having actively integrated the technical and professional skills that cannot be fully developed in the typical junior year communications course and the typical simulated “real world” senior design (capstone) project at most universities. A distinguishing feature of the SPPS program will be the extensive student collaboration with corporate partner alumni and recent retirees along with members of local professional chapters of national diversity and professional societies. Along with coaching and support from faculty and staff, they will mentor and support student managed teams and work groups in the development of a world class co-curricular experiential program that complements the technical skills learned in the curricular Professional Practice Program. Thus, SPPS student members will be empowered to plan, conduct and manage experiential and professional development activities and events in collaboration with corporate partner alums and recent retirees while learning from mentoring professionals.

The Program – Students (rising juniors and seniors) who exceed requirements to maintain a merit scholarship, typically 3.0 GPA minimum, will be encouraged to apply (current resume is their “ticket to play”), develop and participate in creating and implementing the new SPPS program that will include several innovative elements.

- A Student Professional Practice Council (SPPC) will be established consisting of student leaders (rising juniors and seniors) from national engineering society student organizations (ACM, ASME, BSME, IEEE – product vs. process initially), as well as student ambassador teams that will be designated as the point of contact for each corporate partner.
- Each Strategic Corporate Partner has a seat on the SPPC Leadership Board and that seat will actually host a corporate team whose makeup could change depending on the needs of issue-specific work teams throughout the academic year.
- With the coaching, mentoring and support of faculty, staff, alums and recent retirees, student teams and work groups are empowered to manage and participate in personal and professional development activities such as mentoring, interview preparation, corporate hosted networking breakfasts and receptions (campus or company hosted), custom corporate partner information sessions, boutique career events, technical workshops, corporate partner site visits and an annual Day on Campus with each corporate partner. It is requested that corporate partners designate technical and recruiting leads, ideally alums and recent retirees, to coordinate activities with their student ambassadors and their respective student work groups developed by SPPC leadership and their corporate partners.

K-16+ Diversity/Transfer Scholars Initiative – A strong diverse student leadership group is essential to collaborate effectively with corporate partners to address various diversity, equity, inclusion, pathway and pipeline issues. SPPS member student scholar leaders representing national diversity student organizations such as AISES, NSBE, SHPE and SWE establish the Student Diversity Solutions Council (SDSC) in conjunction with their respective local professional chapters. Students, with the support of faculty and staff, will immediately reach out to alums and recent retirees of each Strategic Corporate Partner and local diversity organization professional chapters to develop and manage mentoring, professional development, internship, and various student engagement activities and events. Programs will soon integrate students from partner community colleges, school districts and the various organizations that comprise the higher education ecosystem associated with lead universities of any Regional TUEE Collaboratory.

Transfer Scholars – Due to community college enrollment characteristics in most communities, it is anticipated that most of the transfer students will be low-income underrepresented minorities and women. Highest potential transfer students will be awarded full tuition scholarships and each finalist (typically 3.5+ GPA) has the opportunity to interview for an internship with Strategic Corporate Partners for the summer prior to the academic year as an incoming student. Additionally, upon enrollment in the fall semester, each Transfer Scholar and enrolled finalist will be assigned a SPPS student mentor to help each Transfer Scholar assimilate with SPPS work groups and activities throughout the fall term. An effective Transfer Scholars Program will include at least three key elements: small-scale real-world problem-solving experiences for community college students, participation by corporate partners and SPPS students with community college students in co-curricular activities and events, and clear pathways to transfer, internships and scholarship support.

Founding Strategic Corporate Partner Investment and Benefits – The distinguishing element in both the development and implementation of the model is a new relationship for partnering between industry and education, one in which the companies are viewed not as donors but as investor/partners expecting a strong return on investment while providing new sources of human and financial support for students and student programs. Company employees, especially alums and recent retirees represent critical human and financial resources to complement university faculty/staff and corporate university relations and recruiting professionals who are already working at capacity. Company affinity groups and retiree organizations can provide professors of practice, coaches, mentors, and facilitators for various projects, programs activities and events. Alum and retiree donations along with corporate matching gifts will likely become the primary source for increased program funding as the initiative is scaled.

Strategic Corporate Partners are represented on the Executive Council and the SPPC, SDSC and FPPC industry boards and participate in the on-going development of strategic self-sustaining programs, with expectations for implementation of an innovative corporate/university student-centered partnering program during the 2019-20 academic year. (Note that student, faculty and staff representatives of the SPPC, SDSC and FCCP also serve on the Executive Council.) Strategic Corporate Partners will be invited to invest funds but more importantly encourage employees/alums and recent retirees to help develop, support and participate in SPPS activities and programs. Scholarships are optional for partner companies. Exceptional benefits and return on investment immediately accrue to corporate partners – they will have the opportunity to engage with and hire high potential graduating students and interns for the summer while establishing relationships with a growing contingent of “best and brightest” engineering/computer science students throughout their undergraduate experience. From the inception, all university and corporate partner stakeholders will be mindful of including all undergraduate students in all relevant programs as they are scaled.

Strategic Corporate Partnership Initiative (SCPI) – The goal is to leverage the curricular Professional Practice Program and co-curricular Student Professional Practice Scholars initiatives to create new higher education/industry partnering standards that provide an alternative to traditional university Corporate Partner/Affiliate Programs that tend to treat corporate partners as donors or sponsors of university-developed programs that typically provide various levels of *access* to faculty and students. By engaging corporate investor/partners in creating the sustainable innovations and programs that foster and support student-centered active learning, The Campus immediately enhances existing corporate relationships and develops new ones by encouraging systemic engagement and interactions (not simply access) with students, faculty, staff and administrators. A broad range of programs defined and developed in collaboration with founding Strategic Corporate Partners will include sponsored undergraduate and graduate research, senior design (capstone) and various sponsored projects throughout the undergraduate experience, externships and internships including summer team internships, various student engagement activities and events developed with each Strategic Corporate Partner, The Campus and its faculty, staff and students. Developing specifics of this initiative will be defined in collaboration with Strategic Corporate Partners during the development phase that includes the Inaugural Day on Campus with Strategic Partners (see attachment) when all stakeholders come together for the first time, then implemented through the balance of the 2019-2020 academic year.

The Executive Council will begin discussing the initiative to include graduate level basic and applied sponsored research, a fifth-year applied master’s that includes sponsored graduate level design projects and mentoring/coaching of sponsored senior design (capstone) teams and other graduate-level projects and programs in the 2019-20 academic year and begin scaling implementation in 2020-21.

Although contributions will be encouraged immediately to develop and maintain self-sustaining programs, no investments or fees other than sponsored senior projects will be required of invited founding Strategic Corporate Partners prior to August 2019 when they will have contributed to establishing the proposed new standards for industry/university partnering and collaboration.

Founding Strategic Corporate Partners have the opportunity to participate with The Campus in an unprecedented university-industry collaborative achievement: by June 2020, less than one academic year, to establish the proposed The Campus SCPPL-E initiative as the exemplar scalable student-centered, active learning model for the first regional TUEE Collaboratory. The initiative will facilitate wide spread implementation of ASEE TUEE findings and recommendations to transform undergraduate education in engineering. Most importantly, The Campus students will have the opportunity to realize their full potential and acquire the technical and professional attributes and skill sets to be fully prepared to succeed upon entering the ever-changing technical workplace.

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"It's kinda fun to do the impossible" Walt Disney