TUEE Collaboratory
Transforming Undergraduate Education in Engineering (TUEE)

Proposed Southern California TUEE Collaboratory
Student-Centered Professional Practice Learning in Computer Science and Engineering Initiative for AY 2023-2024 (SCPPL-CSE)

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The emerging national movement to transform undergraduate education in engineering (TUEE) requires a radical shift from passive learning, four years of traditional classroom lectures and job fairs, to student-centered, pro-active, multidisciplinary, active 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.

Curricular changes, including **ASEE TUEE** study findings and recommendations, dominate the many transformation initiatives currently underway at universities nationally. However, the proposed Transforming Undergraduate Engineering Education (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 immediately upon entering the ever-changing professional workplace. *The TUEE Collaboratory model with its flexible framework (see below) is designed to enable any ABET-accredited engineering/computer science program to become a best practice model in the emerging national movement to transform undergraduate education in engineering.*

In preparation for implementation of the comprehensive scalable pilot in the 2023-24 academic year, a small group of about four Strategic Corporate Partners (SCPs) would be invited no later than August 2022 by THE UNIVERSITY to begin collaborating in the design and development of student-centered active learning programs and environments throughout the 2022-23 academic year while establishing new partnering standards for higher education/industry collaboration. Implementation of the first regional comprehensive pilot would occur AY 2023-34 Students would be empowered to engage with practicing professionals 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 would include the extensive involvement of alums and recent retirees (industry and professional societies) 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 who are typically working with a full plate teaching theory and conducting research.

A proposed autonomous "**Academic Skunkworks**" operating environment would be established as a precursor for a center or institute during the 2022 fall semester pilot development phase to facilitate collaboration by the constituencies noted below. *All currently scheduled courses, student programs and events throughout THE UNIVERSITY should be carried out as planned through June 2024* while the elements of the comprehensive pilot are being developed, and then implemented. The *flexible framework*

consisting of four councils (Executive, Faculty Professional Practice, Student Professional Practice and Student Diversity Solutions) developed by early October of the 2022 fall semester establishes the elements for the scalable comprehensive pilot to be implemented throughout the 2023-24 academic year. The Inaugural Day on Campus with Strategic Corporate Partners would be held in mid-October 2022 and would bring all stakeholders together for the first time for an all-day event.

The short-term objective is to prepare and develop the comprehensive 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 AY 2023-24 SCPPL-CSE implementation would include:

- an exemplar Undergraduate Professional Practice Program featuring student centered team-based problem solving and project learning each year throughout the undergraduate experience including a best practice, *sponsored senior design (capstone) program featuring real problems that would be solved by small student teams for at least eight sponsor/customers, at least $20,000 per project, throughout the 2023-24 academic year*. One semester second and third-year sponsored projects would be introduced and conducted during the 2023 spring semester in preparation for implementing the comprehensive pilot.
- a unique Student Professional Practice Scholars program that establishes a *cohort of 40-50 diverse multidisciplinary honors students* engaged in 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. These activities will complement the academic professional practice projects and programs.
- an exemplar K-16+ Diversity/Transfer Scholars model that would *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 in a variety of experiences. In the process of doing so, *new standards for industry/university partnering* would be established that redefine the relationships among the partners. Strategic Corporate Partners are invited to participate in the process of being active investor/partners with faculty, staff and students in the ongoing development of programs and projects that empower students to solve real problems for real customers and take ownership and responsibility for their own personal and professional development.

Undergraduate Professional Practice Program (UPPP) *including best practice Industry Sponsored Second-Year, Third-Year and Senior Design (Capstone) Projects* - The Faculty Professional Practice Council (FPPC) would be responsible for overseeing the overall undergraduate academic student-centered, project learning experiences for all undergraduate engineering/computing students. Included would 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 would be embedded with each project to help assure that each student acquires the oral and written communication skills required in the professional workplace upon graduation. Each Strategic Corporate Partner would have a seat on the FPPC Industry Leadership Board and participate as an on-going, active investor/partner to dramatically redefine and increase corporate engagement. Faculty from CS, ME and EE would be represented along with students.

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 2022-23 academic year. Although a faculty coach (or coaches) is provided for each team, the students would be 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 would be experienced and learned. Third, senior design (capstone) corporate partners/sponsors would provide a stakeholder liaison(s) who maintains weekly contacts with the team for project planning and execution to ensure that 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. Second- and third-year sponsored projects would follow the same format for one semester and would be introduced for the 2023 spring semester as an important aspect for fully implementing the comprehensive pilot throughout AY 2023-24.

Student Professional Practice Scholars (SPPS) – The objective of the SPPS program is to further establish THE UNIVERSITY as an exemplar model for enrolling, retaining and graduating computer science and 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, would participate in creating their own experiences by engaging in real world situations having actively integrated the technical and professional skills that cannot be fully developed in the traditional junior year communications course and the typical simulated "real world" senior design (capstone) project at most universities A distinguishing feature of the SPPS program would 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, practicing professionals would 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 would 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 a variety of mentoring professionals.

The Program – Early fall 2022 semester, students (rising juniors and seniors majoring in CS, ME or EE) who exceed requirements to maintain a merit scholarship, typically 3.0 GPA minimum, would be encouraged to apply (current resume is their "ticket to play") and participate in implementing the new SPPS program that will include several innovative elements.
   • A Student Professional Practice Council (SPPC) would be established consisting of student leaders (rising juniors and seniors) from national engineering society student organizations (ACM, ASME and IEEE), as well as student ambassador teams that would be designated as the point of contact for each corporate partner.
   • Each Strategic Corporate Partner would have a seat on the SPPC Leadership Board and that seat would 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 would be empowered to manage and participate in personal and professional development activities such as mentoring, externships and internships (including summer team internships), hosted networking breakfasts and receptions (campus or company hosted), custom corporate partner information sessions, interview preparation, boutique career events, technical workshops, corporate partner site visits, and an annual Day on Campus with each corporate partner. Corporate partners would 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. Early 2022 fall semester, SPPS member student scholar leaders representing national diversity student organizations such as AISES, NSBE, SHPE and SWE would establish the Student Diversity Solutions Council (SDSC) in conjunction with their respective local professional chapters. Students, with the support of faculty and staff, would 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 would 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 Program (TSP) – 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 3.2+ GPA) would have the opportunity to interview for an internship with Strategic Corporate Partners for the summer prior to the academic year as an incoming student (typically $8-10K in income plus experience acquired.) Additionally, upon enrollment in the fall semester, each Transfer Scholar and enrolled finalist would 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 would include: small-scale real-world problem-solving experiences for community college students, participation by corporate partners, SPPS students and partner community college students in co-curricular activities and events, and clear pathways to transfer, internships and scholarship support.

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. This will 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 UNIVERSITY would immediately enhance existing corporate relationships and develop 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 would 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 UNIVERSITY and its faculty, staff and students.

Founding Strategic Corporate Partner Investment and Benefits – The distinguishing element in implementation of the model is a new relationship for partnering between industry and higher 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 who are already working at capacity. Company affinity groups and retiree organizations could develop programs to provide professors of practice, coaches, mentors, and facilitators for various projects, programs, activities and events. Alum and retiree donations along with corporate matching gifts would likely become the primary source for increased on-going program funding as the initiative is scaled.

Strategic Corporate Partners would be 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 implementation of an innovative corporate/university student-centered partnering program throughout the 2022-23 academic year. (Note that student, faculty and staff representatives of the SPPC, SDSC and FCCP also serve on the Executive Council.) Strategic Corporate Partners would 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 would 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.

The Executive Council would likely 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 2023-24 academic year and begin scaling implementation in 2024-25.

Founding Strategic Corporate Partners have the opportunity to participate with THE UNIVERSITY in an unprecedented university-industry collaborative achievement. The initiative would provide a model to facilitate widespread implementation of ASEE TUEE findings and recommendations to transform undergraduate education in engineering. Most importantly, THE UNIVERSITY students would 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.

Paul M. Jones
President & CEO
Corporate & University Relations Group
Interim Executive Director
TUEE Collaboratory
Mobile: 909-730-4251
Email: paul@curg.net

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

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