**PROJECT NARRATIVE:** *Feasibility study for community-engaged, socially impactful engineering at the University of Washington*

## Executive Summary

Over time, there have been frequent and vehement calls to better educate engineers on the environmental and social implications of their work. Specific educational initiatives and frameworks developed to support these efforts include the UN-sponsored Education for Sustainable Development (Byrne et al. 2010, Desha et al. 2019), sociotechnical thinking (Johnson et al. 2022), corporate social responsibility (Smith et al. 2018), and societal embeddedness (Sprenkeling et al. 2022). Despite long recognition of the need, substantial research has shown that uptake of such initiatives has been uniformly slow and uneven (Zandvoort et al. 2013, Leydens et al. 2022, Gutierrez-Bucheli et al. 2022). The opposition to program reform is generally based on displacement of what are seen as essential technical training requirements, which are often based on industry priorities.

The College of Engineering (COE) is one of the largest colleges at the University of Washington, with ten departments and over 9,800 students, academic personnel and staff. It is also a highly ranked engineering school. However, based on the project team's experience, the COE faces the same constraints as are reported across engineering disciplines as a whole, which are based in systemic, historic, and cultural traditions that ultimately limit students' ability to gain awareness and practical skills in the environmental and social implications of their work (Zandvoort et al. 2013, Leydens et al. 2022).

To address this deficit, the proposed feasibility study will assess the current status of environmental and social impact awareness and training within the COE, and create recommendations for program and curriculum interventions that will support environmental, community, and social justice oriented engineering at the University of Washington. The feasibility study is based on three Tasks, which are: 1) Assess availability and student engagement in existing education and training opportunities related to environmental and social justice, 2) Survey engineering students to evaluate sociotechnical and social justice perspectives, and unmet needs for education and training, and 3) Evaluate program models and curriculum interventions in other disciplines or institutions. The results from Tasks 1-3 will be used to develop recommendations for program or curriculum interventions that could be implemented within and across the College of Engineering.

The project is initiated by members (1 faculty, 2 graduate, and undergraduate students) of the Illimited Lab (https://www.illimitedlab.com/), a bioinspired engineering group within UW Aeronautics and Astronautics. The project outcomes are intended to be cross-cutting, however, and engage and produce results that are relevant to all of the ten departments within UW College of Engineering.

**Project Description and Tasks**

The feasibility study will be accomplished through three Tasks, which are intended to collectively guide recommendations for practical program and/or curriculum interventions by departments within and across the College of Engineering. Please see attached Project Narrative for additional details and information (Tables and Figures) related to these tasks.

*Task 1: Assess availability and student engagement in existing education and training opportunities related to environmental and social justice.* The feasibility study will initiate with assessment of the existing education and training opportunities - both formal and informal - that are available to engineering students. Formal opportunities include required or voluntary courses (e.g., sustainability, social impact, and ethics) offered for academic credit. Informal opportunities include extra-curricular activities that are sponsored or promoted by the University or student groups (e.g., DubHacks, Alaska Environmental Challenge). These opportunities will be summarized for purpose, scope, number of students in each department that participate, and reported learning outcomes.

*Task 2: Survey engineering students to evaluate sociotechnical and social justice perspectives, and unmet needs for education and training.* The second task will be to survey COE students' interest and current knowledge in engineering oriented toward environmental and social justice, and whether there is unmet need for training (see Figure 1, Project Narrative). The survey will be based on existing, validated survey instruments developed to assess sociotechnical and social justice perspectives for engineering students (Leydens et al. 2018, Johnson et al. 2019, Swartz et al. 2019, Leydens et al. 2021). The survey will be developed and implemented under appropriate review by the UW Institutional Review Board. Survey data will be summarized to identify student understanding and identified need(s) for training, and how these may differ across different departments or demographic groups (Johnson et al. 2019).

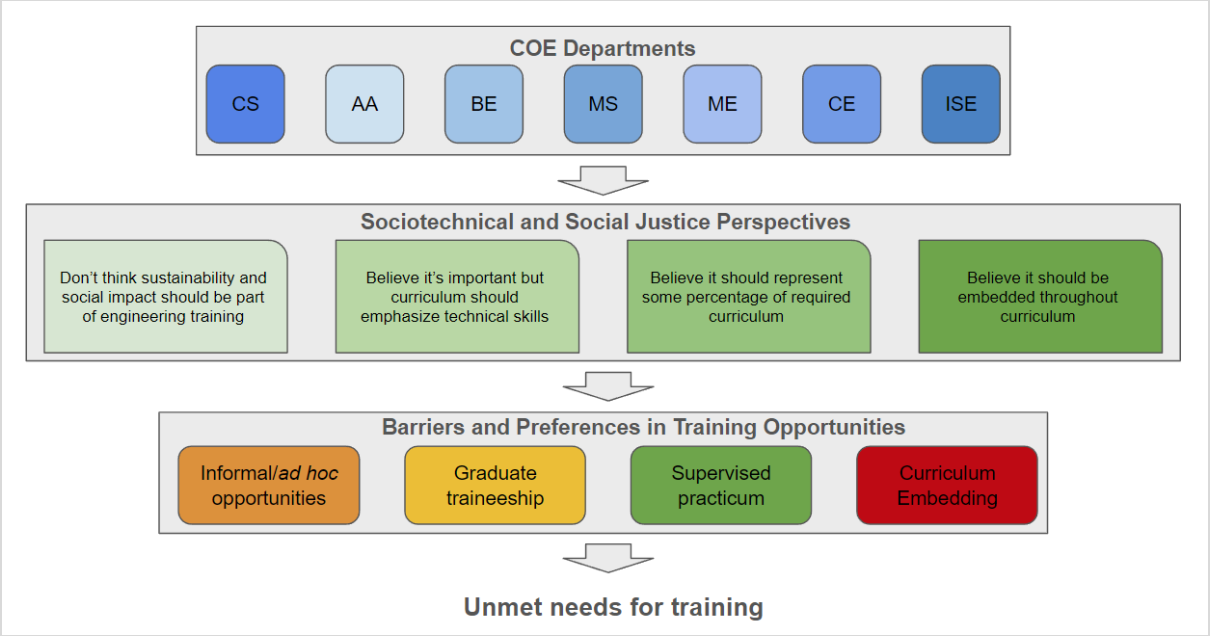


**Figure 1.** Use of a student survey to assess the current state of sociotechnical and social justice perspectives among students within and across College of Engineering Departments. The survey will be designed around validated survey instruments designed to evaluate these topics for engineering students (Johnson et al. 2022, Leydens et al. 2021) and assess perspectives on how students currently view the level of available training. The survey will also use results from *Task 1* and ask students about their awareness, interest, and barriers to participating in current opportunities (e.g., recommended courses, innovation challenges), and their preferences for future training.

*Task 3: Evaluate program models and curriculum interventions in other disciplines or institutions.* The third task will evaluate models for program and/or curriculum interventions that can improve engineering students' awareness of environmental and social impact training (see Table 1, Project Narrative). Interestingly, many disciplines outside of engineering have a long history of community-based practicum or structured programs that allow students to develop their technical skills in practice, often with public serving or community organizations (e.g., law clinics, public health practice). Across UW, there are multiple models ranging from purely curriculum-based changes (e.g., embedding social and environmental impact into technical courses) to practicum-based programs (e.g., matching capstone students with community projects). We have identified 10 programs that offer potential models for expanding students' awareness or practical skills in addressing issues of sustainability, social justice, or community needs. We will conduct semi-structured interviews with directors of each of these programs to ascertain how programs are funded, the intended vs. realized student outcomes, and potential application for engineering students. The interviews will assess how the programs were initiated and are maintained (e.g., student registration, grant funding), department and faculty resources that are required, and administrative or cultural hurdles to implementation.

| Program | Department | Type | Brief Description |
|---|---|---|---|
| Clinical Law Program | UW Law | Supervised student practicum | Students assist clients and communities |
| Alaska Innovation Challenge | Buerke Center | Challenge | Development of marketable technology to solve environmental challenge |
| Holloman Health Challenge | Buerke Center | Challenge | Development of marketable technology to solve health challenge |
| Future Rivers | School of Aquatic & Fishery Sciences | Graduate Traineeship | Students in the program learn to work in career fields outside of academia to create a solid foundation that connects academic, government, industry, and community partners. |
| Engineering in Innovation Health | Mechanical Engineering | Structured capstone program | Student teams work on nominated projects to develop clinical technology solutions |
| Program on the Environment Capstone | College of the Environment | Structured capstone program | Places capstone students as interns with community partners for environmental research |
| Center for Environmental Health Equity | Department of Environmental and Occupational Health Sciences | Supervised student practicum | Matching students to provide technical assistance to community organizations working on environmental health and equity |
| Washington Applied Sustainability Internship | Washington Sea Grant | Fellowship | Interns research identified pollution prevention opportunities at a Host Business |
| Industry Capstone Program | College of Engineering | Structured capstone program | Industry Sponsors bring in projects from their organizations and provide support to teams of creative, talented engineering students who will design and build innovative solutions |
| Engineering Sustainable Design and the Global Community: Environmental Focus | Duke University | Supervised student practicum | Students work with local, national or international community partners to engineer sustainable and cost-effective solutions, many of which address environmental issues. |
| Societal embedding | University of Twente | Curriculum, Administration | https://www.utwente.nl/en/research/vision/ |

Table 1. Model programs and approaches for increasing training and education related to environmental and social impact of engineering practice and designs. Models include short-term voluntary programs that students pursue outside of course curriculum activities (e.g., competitions), voluntary tracks (e.g., graduate traineeship, clinic), supervised capstones or practicums, and embedding in curriculum. A majority of the programs in other departments are at the University of Washington; because related engineering programs are limited, however, those models will be investigated from other institutions.

### Engaging with Communities and Public Service Organizations

A critical part of assessing these other program models is understanding the extent to which students can engage with community-based organizations and work on issues of environmental

and social justice. Programs that match students with industry-sponsored internships and entrepreneurial practice are a common if not expected part of engineering education (e.g., COE Industry Capstone Program); however, these programs are unlikely to include organizations that serve or address community, environmental, or social justice aims. Our assessment will strongly focus on the ways in which other program models are able successfully engage with and bring students' into understanding perspectives and needs of community or public-service organizations. As a final part of Task 3, we will conduct interviews with College of Engineering alumni who work in public service and/or community organizations in our region, to understand some of their constraints as well as identify potential needs that engineering students' skills and the expertise of specific departments may be most aligned with. For example, climate change adaptation (e.g., utilities, infrastructure) is already becoming a technological priority for this region; engineering students in the ME, CEE, and MSE departments are likely to be well suited to assisting in this area. Understanding some of the priorities of community and public service organizations in this region can be part of identifying program interventions that are most likely to be feasible and sustainable.

**Feasibility Study Outcomes**

The results from Tasks 1-3 will be used to develop recommendations for program or curriculum interventions that could be implemented within and across the College of Engineering (e.g., see PASF forms submitted on behalf of the proposal). Such interventions could include (but are not limited to): development of a clinic or practicum program (e.g., School of Public Health, UW School of Law), development of new courses, updates or changes to curriculum requirements, or development of new extra-curricular training opportunities (e.g., Hack-a-thons). The project team will communicate the feasibility study findings to curriculum committees in each COE department, as well the DEI committees in each department.

Along with recommendations, it is expected that the process of conducting the feasibility study will also help identify a network of Engineering faculty, post-docs, and research staff that are interested in collaborating to advance curriculum and program design to support greater environmental and social impact engagement. It is intended that the recommendations from the feasibility study can and will form the basis to develop subsequent proposals to design and implement specific interventions for sustainability and community-oriented engineering. For example, the project team intends to use the results of the feasibility study to support applications to the National Science Foundation (PFE: Research Initiation in Engineering Formation Program and the Responsible Design, Development, and Deployment of Technologies Program. Both of these programs are geared toward engineering education reform.

**Accountability and Feasibility**

Thirdly, the project team is well prepared to conduct this study, and implement the findings. The faculty PI and graduate students who will lead the work have substantial experience of engineering education and research development, in academic, government, private industry labs. This includes experience with implementing a community-oriented research program in

government labs. Importantly, the project team perspectives' are also informed by their direct experience of engineering programs in the Netherlands, where environmental and social learning is integrated throughout undergraduate and graduate curricula and research programs.

**Benefits and Likelihood of Success**

We have many reasons to believe that there is enormous potential to develop an impactful and sustainable program or programs related to increasing student training and skills that integrate technical skills development with awareness of the environmental and social impact of their work. First and foremost, we believe that engineering students themselves are interested in this training, as well as being able to identify career tracks, jobs, and entrepreneurial opportunities that allow them to apply their technical knowledge and skills for societal good. Currently at the UW, engineering students largely follow a "DIY" approach to pursuing interest in environmental engineering (https://www.engr.washington.edu/students/explore/enviro), with minimal credit hours available. We believe that many students would welcome ways in which they could obtain education that integrates technical training with education of social and environmental impact.

Second, federal funding agencies are increasingly aware of and supporting the need for improved practices in engineering, design, and innovation that centers communities and responsible design approaches. For example, one year ago the National Science Foundation created their first new directorate in 30 years, which is aimed at translation of basic research to address societal needs. Agencies like the Environmental Protection Agency are centering equity and environmental justice in new programs, such as the establishment of 17 regional technical assistance centers last year. Long overdue, these national investments stem from a recognized need to address and repair injustices of the past, and continually work toward sustainable development, innovation, and technology practices. Our project team intends to build on this feasibility study by seeking funding for program design or implementation from one or more of these programs, which include: NSF's Responsible Design, Development, and Deployment of Technologies (ReDDDoT), PFE: Research Initiation in Engineering Formation, and the Innovations in Graduate Education (IGE) Program. A further expected outcome of this feasibility study will be identifying a network of faculty (and graduate students, post-docs, and research scientists) that would like to see better training opportunities for students in this space; we believe there is a strong potential for development of a cross-cutting initiative that brings together faculty across the College of Engineering.

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