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WIP: Developing Accessible University-Industry Pathways for Civil Engineering Students with Disabilities

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Introduction

People with disabilities have been referred to as "the original lifehackers" due to the innovative ways they alter everyday products, systems, and spaces to access a world not accessible to them (Jackson, 2018). While innovation and problem solving are core competencies in engineering (ABET, 2021; NAE, 2004), the role of people with disabilities as engineers has not been realized for many reasons, including social and professional stigma, and a lack of support structures that facilitate the entry of engineering graduates with disabilities into the workforce (Daehn & Croxon, 2021; Goggin, 2008; Spingola, 2018). Such access barriers can become even more salient within the context of civil engineering, a trade-heavy industry awash with physical and social demands associated with the design and construction of the built environment. However, civil engineering graduates may pursue a variety of positions, including those that are more office-based (e.g., structural designer) and those that require significant time outdoors (e.g., field inspector, construction manager, etc.). For this reason, the civil engineering discipline offers a unique opportunity to integrate disabled perspectives into the profession, diversify the engineering workforce, and ultimately, promote the overall accessibility of the spaces in which society functions.

In this paper, we provide an overview of the work conducted in the first two phases of a one-year planning project, funded by the National Science Foundation, to increase the representation of civil engineers with disabilities in the workforce. The purpose of this project is to build capacity for engaging industry partners in a long-term collaboration under a shared goal of increasing workforce accessibility for students with disabilities pursuing careers in civil engineering. Specific objectives for this project include: (1) synthesizing relevant literature; (2) identifying and engaging industry stakeholders; (3) exploring collaborative tensions and synergies among industry stakeholders; and (4) developing a robust research agenda for the next phases of the project.

Background

Despite calls from the National Science Foundation and the National Institutes of Health (Bernard, 2021; NSF, 2021), people with disabilities remain severely underrepresented in STEM fields. Current reports estimate that 26 percent (i.e., approximately one in four) of U.S. adults live with some form of disability (CDC, 2018), yet only 20 percent of undergraduate college students and 6 percent of engineering students identify as having a disability (NCCSD, 2019; NCSES, 2019). In industry, engineers with disabilities constitute less than 10 percent of the workforce and are less likely to be employed than non-disabled engineers; those who are employed generally experience lower pay (NCSES, 2019; Pearson & Alexander, 2021).

To-date, scholarship examining the accessibility of academic institutions has focused on the programmatic experiences of undergraduate engineering students with disabilities (e.g., Groen et al., 2018; Pearson Weatherton et al., 2017; McCall et al., 2020; Danowitz & Beddoes, 2022),

with little to no work continuing past the point of graduation. At the same time, research examining the school-to-work transition among engineering students has illuminated many difficulties highlighted by uncertainty, stress, and other unanticipated challenges (Lutz & Paretti, 2021). These challenges intensify for students with disabilities, who must navigate social, physical, and political barriers in addition to those difficulties experienced by their non-disabled peers (Kimball et al., 2014; Groen et al., 2018). To diversify the engineering workforce and broaden the participation of engineers with disabilities in industry, we must develop university-industry-student partnerships that provide disabled students with equitable and informed access to and transition into careers in engineering.

Project Design and Methods

Theoretical positioning

In this project, we move away from charity models of university-industry collaborations and toward partnerships that facilitate mutual benefits and risks among all stakeholders (i.e., industry, university, and students). To build our collaborative capacity, we leverage work exploring collaborative tensions and synergies (Figure 1) to gain insights into establishing sustainable partnerships with civil engineering industry.

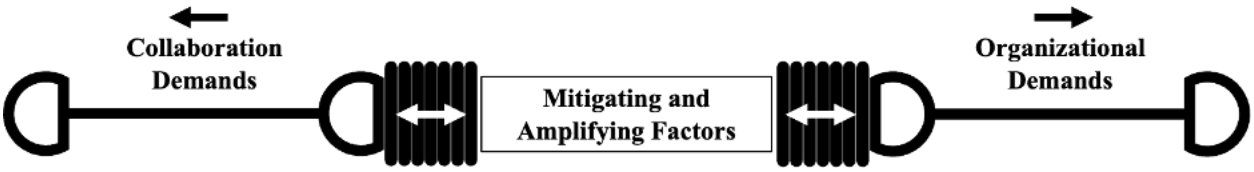

Figure 1: Spring-cable model of dynamic tension in a collaborative ecosystem (Adapted from Gillen et al., 2021)

Specifically, Gillen's Collaborative Ecosystem Model (Gillen et al., 2021) serves as a guiding framework for mapping the components necessary for addressing access barriers inherent to the current school-to-work transition for civil engineering students with disabilities. Overall, we use this framework to inform our literature search conducted in Phase 1 and the development of a semi-structured protocol that guides the sensitizing conversations held with potential industry partners in Phase 2 of the project. Lastly, we leverage Gillen's Model as a roadmap for integrating the findings from this planning project (i.e., Phases 1 and 2) toward the development of a future research agenda in Phase 3.

Phase 1: Information gathering and synthesis

For Phase 1 of this project, we have begun conducting a literature review to examine the research landscape of three topical areas: (1) the engineering school-to-work transition, (2) industry practices for hiring people with disabilities, and (3) university/industry partnerships. By examining the research in these areas within the context of Gillen's Collaborative Ecosystem Model, we seek to address three guiding questions: (1) What are companies' needs, expectations, and policies for hiring employees with disabilities? (2) What factors promote the sustainability of an academic and industry collaboration? and (3) What barriers tend to hinder the collaborative

process between academia and industry? Due to the dearth of research in this area, we conducted an exploratory literature search grounded in terms relating to each of the three primary topical areas guiding this work. Databases known for housing contemporary engineering education literature were strategically leveraged to gain an initial understanding of the broader narratives surrounding civil engineers with disabilities in the workplace. However, we are remaining attuned to research in other venues that focus on publishing disability-related research.

Phase 2: Building relationships through sensitizing conversations

In Phase 2, we have been conducting sensitizing conversations with industry (public and private) virtually using Zoom. Because this is a planning grant, a goal of these sensitizing conversations is to establish the potential for a collaborative partnership between our universities and potential industry partners. To facilitate these conversations and ensure continuity across the topics discussed with each potential industry partner, we are following a semi-structured protocol. Topics guiding the sensitizing conversations include: (1) identifying company needs, expectations, and current policies (e.g., In what ways do you collaborate with universities? What does an ideal industry-university collaboration look like? What are your current practices for hiring people with disabilities in your context?); (2) factors that promote collaboration (i.e., Please describe a valuable industry-university collaboration. What makes collaborating with a university worthwhile?); and (3) barriers that hinder collaboration (e.g., Please describe an instance where the company experienced challenges while collaborating with academia. What made this collaboration a challenge? How were these challenges overcome?). Drawing on Gillen's Collaborative Ecosystem Model (Figure 1), this protocol has been designed to explore the current needs, pressures, wants, and expectations of industry, and we use responses to help gauge the potential for that company as a long-term collaborative partner for future phases of the research.

While students are undoubtedly central to this partnership, we focus our current efforts on the necessary step of securing industry support and establishing a strong collaborative foundation in preparation for future work with students. The desired outcome of these conversations is an established contact at each partnering company across three geographic regions of the U.S. who can contribute to this work and help the research team in addressing concerns and access barriers faced by students with disabilities wishing to pursue careers in civil engineering.

Phase 3: Establishing an informed and robust research agenda

Lastly, Phase 3 of this planning project is allocated to planning the future and ongoing work of this research, and at the time of writing, has not yet been completed. We will apply the outcomes identified through our literature review and sensitizing conversations to collaboratively establish a robust research agenda for project continuation with industry partners. In doing this, we plan to take stock of the current collaborative ecosystem tensions and synergies established among industry partners and the research team, identify leverage points for expanding the collaboration, and solicit feedback to explore opportunities for more funded work. Our goal is that including industry from the outset will help to ensure a successful collaboration in which necessary educational, policy, and hiring practice changes are made together and inform one another with a shared goal of supporting civil engineers with disabilities during their career transitions. We

believe approaching the work in this way will strengthen the likelihood for project success and sustainability long after funding support has ended.

Current Status and Preliminary Findings

To date, we have begun examining literature in our identified topic areas and hosting sensitizing conversations with potential industry partners. Specifically, our literature review in progress has focused on school-to-work transitions for students with disabilities inside and outside engineering; students' experiences with disability disclosure, job selection, and workplace accommodation; and common practices, successes, and evaluation challenges in university partnerships with industry in the context of civil engineering education.

Transitions for students with disabilities into the engineering workplace

The transition from higher education to the workforce poses significant challenges for students with disabilities, particularly in the field of engineering (McCall et al., 2020; Phillips et al., 2022; McCall & Oertle, 2023; Hassard et al., 2024). Despite efforts to narrow employment disparities, systemic barriers, in both educational and workplace contexts, continue to impede equitable access to meaningful and beneficial career opportunities (Kimball et al., 2014; Pearson Weatherton et al., 2017). These barriers include stigma surrounding disability disclosure, inadequate workplace accommodations, disparities in job quality, and limited access to comprehensive healthcare and benefits (O'Rourke, 2021). Many graduates with non-visible disabilities hesitate to disclose their conditions, fearing stigma or discrimination, which can hinder access to needed accommodations (Groen-McCall et al., 2019). Employers' limited understanding of disabilities exacerbates this issue, highlighting the importance of fostering inclusive workplace cultures that normalize disclosure and emphasize employer education.

Additionally, graduates with disabilities often face disparities in job quality and underemployment, frequently working in roles that do not align with their skill set and desired career goals (McCall & Oertle, 2023). Inaccessible workplaces, insufficient career preparation, and inadequate collaboration between universities and employers further hinder their professional development (Goodall et al., 2022; Unger, 1999). Expanding accessible internships, targeted career counseling, and equitable hiring practices is critical to addressing these gaps (Gillies, 2012). Moreover, inadequate mental health support and inequitable workplace benefits create further challenges, emphasizing the need for comprehensive healthcare plans and robust support systems (Gréaux et al., 2023). Addressing these multifaceted barriers requires systemic changes across educational institutions and industries to create inclusive environments that enable disabled graduates to thrive in their careers (Gillies, 2012; Gréaux et al., 2023).

Partnerships with civil engineering industry

Literature regarding civil industry partnerships involving colleges and universities has consistently outlined similar benefits. These partnerships are most impactful when the internships, workshops, and senior design projects provide real-world problem-solving experiences for students. Key benefits for students include improved academic performance, problem solving skills, and the ability to secure more responsible jobs (Koehn, 2004).

Employers, in turn, benefit by enhancing their corporate image, saving operational costs, and recruiting skilled candidates (Haddara et al., 2007). While most studies focused on civil engineering as a whole, some delve into its specific disciplines such as construction management and petroleum engineering. Construction management reflected that effective university-industry partnerships emphasized internships and curriculum updates informed by industry feedback (Tener, 1996). Petroleum engineering emphasized the social aspect field-based education programs provide, by raising student's awareness about companies' obligation to stakeholders, which the study refers to as corporate social responsibility (Smith et al, 2018).

Barriers that have hindered effective collaboration are inconsistent metrics and methods for evaluating partnership outcomes, as well as integrating theory on the mechanisms that drive successful partnerships. Additionally, there is a lack of studies on industry-university partnerships within civil engineering sub-disciplines, each of which has unique demands. Bridging the gap between soft skills and social considerations into the civil engineering curriculum can be explored as well (Koehn, 2004).

High Level Findings and Next Steps

Our exploration of the literature has revealed that much of the existing research focuses on the experiences of undergraduate engineering students with disabilities and their experiences, rather than on the specific needs of disabled civil engineering students' transitions into industry and how they are and can be supported once they get there. In sensitizing conversations with potential industry partners, representatives have been open and eager to recruit qualified, disabled civil engineers; however, confusion exists regarding how to approach accommodation implementation. One specific need that has emerged is to probe deeper with industry around buzzwords in hiring. For example, what does it really mean to be "qualified," and what is included under the umbrella of "reasonable accommodations?"

Our next steps include continuing with our literature review and sensitizing conversations with industry. In addition to this, we would like to secure industry collaborators and develop a robust plan for future funding. Overall, our goals are centered around building capacity to engage industry in a multi-stakeholder partnership to ultimately broaden the participation of civil engineers with disabilities in industry. This initial project will contribute to a deeper understanding of existing scholarship and current industry perspectives, provide an initial framework for developing our partnerships between academia and industry, and blaze a trail forward for creating a more diverse and inclusive engineering workforce.

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