

Epilogue

Social science and humanities scholars can do better than “snapping at the world, as if the whole point of being and thinking is just to catch it in a lie.”¹ Cultural critique is a vital and often undervalued scholarly agency, and critical reflection is a prerequisite to creating more just and caring worlds. Social science research unwaveringly shows that the technoscientific, corporate, and industrial forms we critique are borne out of global economic and political assemblages that are produced through the maneuverings of elites. But they are also partially brought into being through the deceptively mundane practices of people whose work brings corporate forms to life.

In this book I have argued that, to *understand* the accountability of technoscientific corporations, we must understand the agencies of the people who constitute them. In this epilogue, I sketch the contours of one way we might *alter* the accountability of technoscientific corporations by altering the agencies of the people who constitute them: critical participation in engineering education. The activities I analyze here emerged from much larger and collaborative attempts to create a space inside the Colorado School of Mines that was accountable to diverse scholarly identities, to the unique mission of the school, and to the aspirations of engineering faculty and students.² Much of this work involved other faculty at Mines, especially with engineers and social scientists affiliated with the Humanitarian Engineering program I directed with Juan Lucena. While I do not advocate for this approach as a universally desirable or the only mode of critical participation, I hope that making my efforts visible will inspire other critical

reflection on our academic practices. Not all humanities or social science scholars aspire to enter into the worlds we critique, and forced participation is experienced as co-optation.³ But each of us is already a participant in engineered systems as we live with the artifacts of engineering practice in our everyday lives. Those who teach engineers play a special role in shaping their positionality, subjectivity, and expertise.

Gary Downey's opening provocation in the journal *Engineering Studies* proposes "scalable scholarship" to avoid the "comforts of resolute pessimism and the pursuit of isolated critical virtuosity." Scalable scholarship takes seriously that which is otherwise dismissed as external to or derivative of our research: its relevance to and potential uptake by our students, our interlocutors, and other audiences.⁴ Like others in the field, I seek, as Dean Nieuwma proposes, "to produce scholarship that informs critical participation in engineering educational reform [and] to actively participate in such reform efforts and to reflexively analyze and refine that participation."⁵

Participation in education reform feels especially pressing in engineering, an early and prominent example of corporate influence over university curricula.⁶ In my own case at Mines, my job talk—a critique of corporate social responsibility (CSR) in mining—took place in the then brand-new petroleum engineering building, where people filed into classrooms, lecture halls, labs, and study spaces underneath the full-color logos of oil and gas companies. Scholars argue that such influence has strategically blinded engineers to how "technical systems enable different structures of power."⁷ Concerning the oil and gas industry in particular, science and technology studies (STS) scholar Sara Ann Wylie argues that companies and engineering universities promulgate a long history of promoting industrialization at the expense of rural people by "approaching natural gas extraction as a technical practice rather than as a political practice with social ramifications."⁸ It is precisely the dominant image of engineering as a purely technical practice that my colleagues and I seek to interrupt in our teaching and pedagogical collaborations at Mines and elsewhere.

Our efforts in both program building and teaching make visible and disrupt a pervasive divide between the technical and the social that pervades engineering education and practice.⁹ This divide has been a part of

academic work since Enlightenment knowledge production systems organized knowledge into discrete disciplines, distinguishing the humanities from the sciences and technology from society. This system turned science into a factory, in which knowledge could be produced through a division of labor where each discipline has its own ontology, communication, and community.¹⁰ This intellectual inheritance animates a long history of efforts to cordon off engineering knowledge from the humanities and social sciences and systematically devalue the latter. Those boundaries were reinforced over the past century in the United States, as practicing engineers and engineering educators called for scientizing engineering practice and knowledge in order to remain competitive in the Cold War.¹¹

Those histories continue to reverberate in the undergraduate engineering curriculum encountered by students, as it artificially separates social from technical knowledge and systematically devalues the former.¹² In a large, longitudinal study of undergraduate engineering students at multiple institutions, Erin A. Cech demonstrated that engineering students' commitments to public welfare decreased the longer they were in school, what she identifies as a pervasive "culture of disengagement that defines public welfare concerns as tangential to what it means to practice engineering." She insightfully proposes that this culture of disengagement is rooted in the "ideology of depoliticization, which frames any 'non-technical' concerns such as public welfare as irrelevant to 'real' engineering work; the technical/social dualism, which devalues 'social' competencies such as those related to public welfare; and the meritocratic ideology, which frames existing social structures as fair and just."¹³ This institutional context of engineering learning means that social responsibility can be taught in the most microethical of approaches, encompassing adherence to law, rather than a macroethical approach to critiquing the contribution of science, engineering, and technology to social and environmental (in)justice.¹⁴

No single definition of socially responsible engineering is taught at the undergraduate level, reflecting a broader lack of consensus in the profession as a whole, and very little research investigates what engineering students actually think socially responsible engineering is. Many retreat into small acts of personal responsibility and charity, while others hope that,

by serving their employers and clients “faithfully and professionally, it will somehow all work out in the end.”¹⁵ Greg Rulifson and Angela R. Bielefeldt offer one of the few longitudinal, qualitative studies of how undergraduate engineering students actually understand social responsibility. For the students who stayed in engineering, Rulifson and Bielefeldt identified a convergence of themes that included “not harming environment, moving society forward, helping the impoverished, following the law, safety, serving company, helping people, behaving ethically, [and] serving clients/end users.”¹⁶ Significantly, they found that over time themes such as moving society forward and helping the impoverished decreased in importance, whereas safety, serving the company, and serving clients/end users increased. This suggests that, much as in Cech’s research, students came to view engineering as serving a smaller role in improving the lives of the marginalized and disadvantaged and to place greater importance on company loyalty as they progressed through the curriculum and internships. Moreover, Rulifson and Bielefeldt found that students with a high commitment to social responsibility often left engineering when they encountered unsupportive environments, decontextualized technical courses, and curricular difficulty.¹⁷

The intertwined ideology of depoliticization, technical/social dualism, and meritocratic ideology inform how engineering students come to think about their own accountabilities. I therefore aim to analyze and teach CSR as a sociotechnical field of practice inflected by structures of power, making visible and challenging the deeply divided institutional structures experienced by students and faculty. At the beginning of this intertwined ethnographic and educational research project on the intersection of engineering and CSR, I hoped that helping engineering students puzzle through the opportunities and limitations of CSR as a framework for engineering accountability would help mitigate the troubling and endemic culture of disengagement in undergraduate engineering education. I set out to use my ethnographic research to propose more robust notions of accountability for engineers from different spaces of the curriculum, from the social science elective I taught to their majors’ core engineering courses.

FRAMING ENGINEERING FROM THE LIBERAL ARTS

Mines students are like other engineering undergraduates who have precious few opportunities to take courses in the liberal arts. Of the nearly 140 credit hours required for mining or petroleum engineering degrees at Mines, for example, a scant 15 are reserved for training in the humanities and social sciences: a first-year writing and environmental ethics course, a second-year global studies course, and three upper-division electives of a student's choosing. Nieuwsma underlines the potential power of STS-infused liberal education courses, even when few in number, "to provide the curricular, conceptual, and pedagogical frameworks to situate students' engineering coursework (i.e., the technical core) as well as their identities within a more expansive vision of engineering as occupation as well as of engineering in society more broadly."¹⁸ I aspired for my Corporate Social Responsibility course to do this work for students at Mines, specifically by nurturing other kinds of agencies than students found in the rest of their technical coursework.

Since 2015 I have regularly taught Corporate Social Responsibility as an upper-division social science elective that facilitates a critical social science analysis of the concept and its use in practice. Through reading ethnography and industry reports, the students map out and critique the concepts and underlying assumptions that animate CSR as a field of practice. We identify an underlying politics of commensuration at work in the common practice of weighing trade-offs in engineering decision making.¹⁹ Those trade-offs belie the harmony ideologies we encounter in most corporate publications, inspiring students to ask hard questions to wrestle with competing accountabilities. We analyze CSR as one among other frameworks for understanding the accountabilities of business to society. We explore how the CSR framing makes certain kinds of questions visible—or not—compared with other frameworks, such as government regulation, environmental justice, and sustainable development. We debate the merits and disadvantages of each framework for understanding corporate accountability. Students find that, for example, while the framework of environmental justice facilitates their bringing unequal distribution of benefits and harms

to the fore of debates about business practice, CSR discourses steeped in the social license to operate more often led them to aspire to financial wins, such as those offered by the engineers in chapter 6.

Through these activities, we unearth the inherent politics of such terms as *stakeholder* and *social license to operate*. I invite students to see the power implicated in who gets to define legitimate stakeholders and or the “problem” of resource development engineers seek to solve. As much as possible, we try to widen our analysis beyond the operations phase privileged in very term *social license to operate* to consider the (in)justices involved in project planning.²⁰ This illustrates how the problem definition stages are where accountabilities that cannot be reconciled with profitability can be defined out of the “problem” of resource development. Hoping to upset the sociotechnical divide that would position CSR as a domain of anthropologists separate from engineers, I challenge students to redesign part of the project—such as by relocating wells, redesigning a pit, or creating new systems for safety management—based on the concerns of the publics they identify. When those concerns cannot be satisfactorily addressed through changes in engineering decision making, it places us squarely in discussions about *whether* industrial activity should take place, not just how it could be done responsibly.

To gain support for the new images of engineering and accountability I propose through the class, I enlist the support of engineers I have come to know during my research. These visits are some of the most meaningful parts of the class, especially by presenting students with a wider variety of potential engineering career trajectories than they are accustomed to imagining. A perennial favorite is Chuck Shultz, a Mines alum and oil and gas executive who has become one of our strongest supporters. Troubled that shortsighted engineering decisions have generated prominent conflicts, he has embarked on a mission to ensure that engineers can integrate social responsibility into their decision making, thus seeding greater accountability from the ground up. He has also inspired students to see the impact of leadership in setting a “tone at the top” that fosters social responsibility throughout the organization. He demystifies the corporate form by explaining the relationships among senior leadership, boards, and shareholder representatives. Speaking from his own experience, he shares

how he has wrestled with difficult decisions that require him to balance accountabilities to shareholders, to employees, and to the people and places where they operate.

Our visitors consistently build up their proposals for new kinds of socially responsible engineers by intervening in existing professional ideals. Aaron's mission to change how his industry engaged the public, he made clear, required transforming the dominant images and practices of engineering inside of that industry (see chapters 1 and 6). In my class, he grounded his call for new kinds of engineering practices in the disciplinary identity he shared with the students, speaking with the *we* of engineers: "Engineers are problem solvers, but social relationships can't be solved, just managed. There's no formula. Engineers, we love to solve and delete problems, instead of working on the adaptive ones that don't go away because they are about relationships and context, and those change." Aaron invoked the powerful and pervasive identity of engineers as problem solvers but redefined the problems engineers were supposed to be solving to be the perplexing and ever-shifting ones of social acceptance and social responsibility.²¹ For him, "managing" rather than solving those problems demanded characteristics that were simultaneously being advocated by some engineering education reformers, such as recognizing that other people may define problems differently, listening to those others to better understand their perspectives and concerns, and seeing engineering practice as sociotechnical rather than separable from political, economic, and social matters. I also hope to nurture those characteristics in my students through the course, making Aaron's visit a source of support from inside of an industry that holds substantial symbolic and financial capital on the Mines campus.

COLLABORATIONS WITH ENGINEERING PROFESSORS

The CSR elective course provides some opportunity to shape how students perceive what they encounter in the engineering core by presenting them with a social science critique of dominant modes of engineering and engineering education. But I was also eager to participate directly inside

of engineering classes themselves, hoping to send the message that public accountability was central to the profession itself, not something that ought to be outsourced to social scientists.

In 2013, a year after my arrival to Mines, Carrie McClelland, a civil engineer with a background in community development who was teaching in the petroleum engineering department, invited me to lecture about the importance of stakeholder engagement in the required senior seminar she taught. Colorado was in the midst of the controversies accompanying the oil and gas boom (see chapter 1). To try to gain the trust of students I perceived to be skeptical, I began my lecture by making visible my personal ties to mining—a similarly vilified industry—and invoked the business-friendly “cost of conflict” to justify taking social and environmental performance seriously. I showed them different strategies for prioritizing stakeholders, leading them in an exercise in which they ranked stakeholders based on different criteria. My goal was for them to discover how stakeholder engagement was not an objective exercise but one steeped in politics, assumptions, and company policies.

We started by prioritizing criteria that privileged groups that were powerful squeaky wheels—those that wielded a considerable amount of influence to impact a company’s ability to operate. I then invited them to consider other criteria, such as proximity, level of impact by the operation, and need for economic development. These criteria resulted in an entirely different ranking list, which provided the platform to propose that stakeholder engagement was a political activity inflected with the values of the person doing the ranking. I then gave them a few examples in which companies had chosen to explicitly exclude some potential stakeholders from the list in order to delegitimize them. McClelland’s and my perception of the success of the experiment paved the way for more in-depth collaboration in the course over the next four years. We created assignments and role-playing exercises and brought in guest speakers from industry and my research project. By my last semester participating in the course, students felt comfortable enough even to propose social justice as one of the ranking criteria.

This work was bolstered by the National Science Foundation funding I received from the Cultivating Cultures for Ethical STEM program,

which provided me the institutional legitimacy and funding to scale up those collaborations in her class and others. Nicole Smith and I convened a workshop in August 2016 that drew mining and petroleum engineering professors from Mines and the other participating institutions, plus CSR practitioners from the Denver area. We began interviewing engineers, creating productive synergies between the ethnographic research and our teaching activities. John, the engineer who worked on performance standard compliance for oil and gas projects around the world, worked with us to develop a semester-long project that invited students to step into the shoes of an engineer working on the controversial project in the South Pacific, charged with assuring its fidelity to the global performance standards for social and environmental responsibility. He also traveled to Golden, Colorado, to lecture to McClelland's class as well as to the campus as a whole.

Even though the senior seminar was required by the petroleum engineering degree program, and Carrie McClelland and I made efforts to use it to rethink dominant engineering practices, its status as the “professional skills” class led it being perceived as still separate from the technical core of the program. To begin working inside that core, we worked with Linda Battalora, a fellow professor in the department who held terminal degrees in both petroleum engineering and law. Crucially, Nicole Smith helped devise readings and activities about CSR for the required field session (figure E.1), an important rite of passage in which students spend a few weeks in oil-producing regions to tour production sites and learn firsthand from practicing engineers. Nicole Smith also attended one of the field sessions in California to lead those activities and insert questions about social responsibility into their site visits. In the following years, the field session faculty continued using the assignments we developed.

Linda Battalora also worked with us to institute two CSR-themed project-based learning exercises in two of the other courses she taught: Reservoir Fluid Properties and Mechanics of Petroleum Production. In each course, we hosted a mock “community meeting” similar to those that Aaron and others developed for communities undergoing unconventional energy development (chapter 4). Students created an exhibit that explained a dimension of one of their course themes—for example, oilfield



Figure E.1

Students visiting a production site during a field session for the Petroleum Engineering course, 2016. Photo courtesy Linda Battalora and Nicole Smith.

water—in a way that was meaningful to the people likely to attend such a meeting. We brought in students from my CSR class, other professors, and local research participants—including Art Biddle—to play the roles of various members of the public. We evaluated the students in their ability not just to present technical information but to listen and then understand and respond to expressed concerns in an appropriate manner. These efforts were significantly aided by the participation of Ray Priestley, a Mines alum and geological engineer who has taken an active role in visiting Humanitarian Engineering classes, developing assignments, and helping found an alumni interest group focused on social responsibility. I also engaged in more limited collaborations with other professors, including helping develop case studies and lectures for the Formation Damage and Stimulation course and Senior Design course, including working with John to create a lecture and assignment on risk assessment. Within a few years of the National Science Foundation project starting, petroleum engineering students encountered CSR in each year of their undergraduate training,

inside of their “core” curriculum. The grant also allowed us to scale up the work to other courses at Mines, as well as at Virginia Tech, Marietta College, and the South Dakota School of Mines and Technology.²²

ASSESSING CHANGES IN STUDENT KNOWLEDGE AND ATTITUDES

My colleagues and I were eager to gauge if and how our courses affect students’ knowledge and attitudes surrounding the intersection of CSR and engineering. We have developed a variety of techniques for assessing changes in their knowledge, attitudes, and skills, including a survey instrument that we deploy in our courses at Mines, as well as in courses of our collaborators at Virginia Tech, Marietta College, and the South Dakota School of Mines and Technology. Students took the survey at the beginning of the course and again at the end, allowing us to compare their responses.²³ Between 2016 and 2020 we had compiled matched pre and post data for nearly one thousand students.²⁴

One of our first findings was that our work in the petroleum engineering senior seminar led to students being more readily able to identify the social and environmental dimensions of a corporation’s responsibilities to the public and its stakeholders. The students still struggled, however, to connect CSR directly to their professional activities as engineers.²⁵ We saw greater improvements in this area in the petroleum engineering field sessions.²⁶ In the first summer, for example, we observed a statistically significant change in student responses to the question, “To what extent do you think CSR will impact your work as an engineer?” At the start of the summer session, responses were roughly evenly split between “very probable” and “somewhat probable.” By the end of the course, 100 percent of the students who participated in the field session with Nicole Smith and Linda Battalora responded with “very probable,” along with about 70 percent of the students enrolled in the field sessions that used the same material but did not include a social scientist on the trip. That same summer, we observed statistically significant improvements in students recognizing that companies are accountable to “activists opposed to their industry” and

“civil society organizations.” In the field session attended by Nicole Smith, for example, just over half of the students began the session recognizing companies’ accountabilities to activists. By the end, 90 percent did. We saw a smaller but still significant jump in the following year’s field session, which used the same material but did not include a social scientist on the trip.

Our next studies broadened our scope to assess and compare student learning across the courses and universities. Overall, students were better able to define CSR and recognized accountabilities to a broader array of publics, such as activists and civil society organizations.²⁷ They also ended the courses expressing greater desires to work for socially responsible companies.²⁸ We found empirical evidence that women students at all of the institutions expressed greater desires for careers at socially responsible companies. We also found that students’ opinions about social responsibility varied substantially by school, pointing to the significance of institutional culture. The mining engineering students at Virginia Tech, for example, consistently self-reported higher desires to work for socially responsible companies than did the engineering students anywhere else, including at the Colorado School of Mines.²⁹ While we do not know why Virginia Tech students’ scores are so much higher than their peers’ on the same question, we note that Virginia Tech actively promotes a culture of service among all of its engineering students.

Much to our chagrin, we did not find concrete evidence that a particular category of course—elective versus required, social science versus engineering—consistently enhanced students’ attitudes about the intersection of engineering and social responsibility. Nor did we find a clear pattern in the timing of the course in their undergraduate curriculum, as we have evidence for statistically significant improvements for students in their first, second, third, and fourth years. We did find some evidence that specialized elective classes such as the CSR course I taught may be “preaching to the choir,” as many educators suspect. Those students began with higher scores in response to the question asking them to rate their desire to work for socially responsible companies than any other of the Mines students in our sample.

The one course that consistently saw statistically significant improvement in students' knowledge and attitudes about social responsibility was a first-year seminar taught by petroleum engineering faculty at Marietta College. The students began the course with significantly lower expressed desires to work for socially responsible companies and weaker definitions of CSR than students at other universities but ended in the same range as their peers. Unlike the other courses, the seminar focuses on helping students make explicit connections between personal and professional responsibility, fostering what Nathan Canney and Angela Bielefeldt theorize as professional connectedness.³⁰ It is likely also significant that Marietta was the only liberal arts school included in our study, which could have a variety of effects on student self-selection into the program and the broader messages they are receiving about social responsibility.

To our surprise, the statistically significant improvements we observed in students' desires to work for socially responsible companies did not seem to correlate with those students coming to view CSR as an integrated, sociotechnical phenomenon. Our initial hope and hypothesis was that, if students could come to see CSR as sociotechnical rather than as simply social or technical in nature, they would be more likely to embrace it in their own career aspirations. Of the seven courses that demonstrated statistically significant changes in students' desires to work for a socially responsible company, only one also showed improvements in recognizing CSR as a sociotechnical practice. The other six showed that despite our best efforts, students were more likely to come to view CSR as the "old" CSR practices, such as volunteering, providing scholarships, and engaging in charity work, rather than the "new" CSR practices that made engineering itself more accountable to stakeholders. This finding may point to the difficulty of disrupting engineering students' tendency to engage in compartmentalization when imagining their future careers, viewing social responsibility as something important to them yet separate from the practice of engineering itself. We also, however, caution against judging the value of pedagogy by statistical significance alone. Students began many of the courses already recognizing CSR as a sociotechnical phenomenon, which would not result in gains that were statistically significant.

Our most disappointing finding was preliminary confirmation of a “social responsibility slump” as students progressed through their undergraduate curriculums. We were able to track four cohorts of students from year to year rather than just from the beginning to the end of a course. With few exceptions, these students ended their courses expressing greater desires to work for socially responsible companies, but they then began their *next* courses expressing *lower* desires than they had at the beginning of the previous course.³¹

One possible explanation is the social desirability bias in survey research, which shows that people answer sensitive questions with socially desirable rather than truthful answers. In our case, this means that students may have reported greater desires to work for a socially responsible company because they received signals during the semester that their professor held that view, and they were answering the survey questions in what they viewed as the “correct” way. We attempted to mitigate this bias by informing students in person and on the survey itself that their professor would not see their responses, but it is difficult to avoid this bias completely.

Aside from the social desirability bias, there are other possible reasons that students’ attitudes may improve at the level of a class but lose ground as they advance through their undergraduate years. They may be experiencing the effects of the culture of disengagement documented by Cech. The technical/social dualism animated course flows at each of the universities and many students’ perceptions of the value and difficulty of the “technical” courses inside of their majors and the “social” electives outside of them. Faculty perceived that students became immersed in their technical courses and could become a bit myopic when enamored of the new engineering concepts and industrial applications they are learning. Many of our students reacted strongly when they encountered CSR content in their technical courses, especially when those CSR concerns were raised as criticism of an industry they were aspiring to join.

The “culture of disengagement” argument focuses on students’ experiences inside universities. For our own research, we cannot say that changes in student responses were solely due to their course experiences, since they all were taking other courses taught by other professors and absorbing

information and perspectives from outside sources, such as news outlets, internships, and social networks. What we do suggest is that, in addition to the messages that engineering students receive inside universities and through the curriculum, students are powerfully affected by the messages they receive from practicing engineers and employers during internships.

Emily Sarver conducted precourse surveys of the students in the sophomore and senior mining engineering courses at Virginia Tech between 2011 and 2013, prior to our research project. She found that romanticism evident among the sophomores about their ability to use engineering to promote sustainability and social responsibility had tempered by the time they were seniors. For example, one sophomore student wrote, “I like that mining engineering is involved quite a bit with the business end of operations . . . and things like ensuring good social license is just as important as the engineering itself.” Another sophomore wrote, “I like the direction that the industry is moving by putting such a focus on sustainability. I’m excited to be part of a generation of engineers that are more conscious of the environment than ever before and I think we can make a difference in an industry that has had such a dirty connotation for so long.” In contrast, a senior wrote that the concepts in the Mine Reclamation and Environmental Management course “aren’t really applicable to what most mining engineers are going to be doing in the industry.” Another senior wrote that most of their “impressions of what to expect have come from professors and people I’ve met through internships. For the most part these people have shown a dislike for the environmental and regulatory requirements placed on them because they slow down production.”³² Working experiences may thus provide students an immediate sense of the multiple constraints that exist on engineering practice, in tension with social responsibility goals. This experience may prompt them to be more pragmatic or restrained in their social responsibility aspirations.

It may also be that seniors self-report lower desires to work for companies with positive reputations for social responsibility because they have already accepted job offers at companies with average or poor reputations in this regard and are calibrating their expectations to what they encountered on the job market. Moreover, the strength of the job market may make a difference in students’ aspirations. In 2015, oil prices fell from

near-record highs and production declined dramatically, reversing a boom in production and well-paying jobs that had originally attracted many students to study petroleum engineering. This market contraction meant that in 2015, 2016, and 2017 companies made fewer job offers and frequently rescinded offers that they did make. The lower scores for the earlier cohorts of petroleum engineering students may signal that they were willing to accept a job at any company, with less regard for their reputation, because they perceived that they had few options open to them.

In our ongoing and future research, we are keen to see if there is a relationship between students' career aspirations, their views of engineers' agency, and their views of corporations. Are students more likely to aspire to socially responsible careers if they believe that engineers can actively shape decision making that affects the well-being of people and the environment? If they view the activities undertaken under the banner of CSR as something that they will personally have to do as engineers? If they believe that CSR can actually improve industry practice instead of serving as public relations greenwash?

CONCLUSION

If CSR is a vehicle to extend the moral authority of corporations,³³ I have often worried that our collaborative teaching and institutional transformation efforts will facilitate that expansion. Many of our students go on to work in both large and small companies connected to mining and oil and gas activity, and I derive a great deal of satisfaction imagining how their engagement with critical social science will change how they do their engineering work—ideally to encompass the concerns of people who bear the greatest harms of industrial activity. Yet the more corporate personnel admit mistakes on a journey of “continuous improvement,” the more they are able to incorporate stakeholder concerns into their outreach and operations, and the more they are able to extend the reach of corporate forms. This creates a potential catch-22: the more critical and self-reflexive my students become, perhaps the more they enable the expansion of the corporate forms employing them.

Doing nothing and retreating into social science research and teaching, disconnected from the teaching and practice of engineering, is also problematic, a form of purity politics that belies our personal and institutional imbrications with the mining and oil and gas industries in particular and with corporate forms in general.³⁴ I sympathize with my interlocutors' argument that we are all to some degree complicit in these industries—in different ways and to different degrees—given our dependence on them in our everyday lives. As problematic as the ethic of material provisioning is, it endures because it holds some truth. It also seems naive to pretend that our academic enterprises can be completely purified away from corporate interests, given the long history of corporate involvement in education in general, especially in engineering. We can make corporate influence visible and strategically work within, alongside, and against it, but we cannot ignore it. Finally, I see and hear a clear desire among engineers to learn from the research that social scientists have done.

The main concern of critical participation, then, becomes managing three risks outlined by Downey and Lucena: (1) co-optation, or the transformation of a project into “something indistinguishable from that which it studies”; (2) social engineering, or “presuming that one's expertise warrants the authority to legislate change through a research project”; and (3) rejection by the people with whom we seek to collaborate.³⁵ Our internal use of CSR concepts shored up institutional legitimacy for our projects of transforming engineering education but also risked cooptation by adopting the language of industry. To mitigate this, we presented CSR alongside other frameworks that questioned the universalization present in the cost-of-conflict market logic, posed different images of the obligations between companies and their publics, and raised the possibility that those publics defined “progress” or a “good life” differently than did engineering-trained corporate personnel.³⁶ To discourage social engineering and rejection, we took care to engage in “mutual critique.”³⁷ I have opened up my research and teaching to critique by engineers by becoming a regular presenter at mining engineering, petroleum engineering, and engineering education conferences, and I have joined my collaborators and students in thinking through the strengths and limitations of ethnographic analysis. If we desire

our engineering students to demonstrate more humility in accepting the limitations of their work and their larger disciplines, we must be willing to do the same.

It is in that spirit of humility that this epilogue has outlined some of the collaborative, interdisciplinary efforts at critical participation that co-evolved with the ethnographic research analyzed in the rest of the book. Quantitative survey measures can only tell part of the story of the impact of our teaching. I remain inspired by the many engineering students, professors, and practitioners who recognize—and sometimes relish—perplexity, using it as an opportunity to rethink their assumptions rather than denigrate people who hold different judgments of what the world is and what it ought to become.³⁸ I am buoyed by the many engineering students, professors, and practitioners who use those reflections to ask *whether* natural resource production should occur in particular places, in addition to how it can be done more responsibly. For those who seek transformation in the corporate forms that shape so many aspects of our everyday lives, we would do well to think with the people who enact them.

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Extracting Accountability

Engineers and Corporate Social Responsibility

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