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Minoritization Processes in Structural Engineering Diversity Work

Dr. Lara K. Schubert, UCLA; Cal State Los Angeles; Cal Poly, San Luis Obispo

Lara K. Schubert is a research affiliate at the UCLA Center for the Study of Women. She is a former full-time structural engineer who works in feminist studies of science and technology, teaching on these topics at California State University, Los Angeles and California Polytechnic State University, San Luis Obispo.

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Introduction

As articulated in the call for papers on the minoritization processes in engineering education, minoritization can stem from the "discriminatory disciplinary chauvinism such as the categorization of 'rigor' or 'soft skills.'" This sort of chauvinism, marked by what counts as knowledge and what types of work and expertise count for advancement, is also made visible through study of an effort to make engineering fields more diverse and socially responsible. I have observed how the hierarchy of knowledges within structural engineering affects the efforts of an initiative within structural engineering called SE3, Structural Engineering, Engagement and Equity. This paper shows through spotlighting SE3 specifically how the hierarchy of types of knowledge and values within structural engineering put an increased burden on engineers who work on issues of diversity, equity, and inclusion because the work goes unrecognized and does not explicitly count for advancement. [1] This can be broken down as follows: First, there is a hierarchy at play in the commonly recognized binary classification of technical vs. social or non-technical. SE3 does not count as technical and so work in this committee does not count in performance reviews the way professional service work in technical committees does. Second, billable work is valued over non-billable work. Because there is no existing calculus for determining the monetary value of the work of SE3, it is not valued in the same way as directly billable work or labor that is indirectly profit generating (like developing relationships with clients). Because it is not adequately valued, engineers who give time to SE3 to work toward social equity, in and through engineering, experience negative repercussions, which also hinders the goals of the initiative. In order to achieve goals of improved diversity, equity, and inclusion in the field and social equity through design, this work must be recognized through translation to existing values or reconsideration and reestablishment of foundational values.

Methods and positionality

This paper comes out of research on an initiative within the professional engineering society, which started in the Northern California chapter (SEAONC, Structural Engineers Association of Northern California) but now is part of a nationally coordinated effort (through NCSEA, National Council of Structural Engineers Associations) with many chapters in many different states. To learn more about this work and to glimpse the strengths and weaknesses of the initiative, I interviewed past and current leaders of SE3 from SEAONC, reviewed materials available on their website, and looked at some internal resources that were shared with me. I interviewed ten people between April 2022 and August 2022 via zoom. I have kept their quotations anonymous and sent a draft for their review, to be sure that no unwanted identifying markers remained. Prior to this work, I contacted the UCLA Institutional Board of Review about this project, explained my research methods in this inquiry. The Administrator of the South General IRB from the UCLA Office of the Human Research Protection Program informed me via email on March 23, 2022 that formal review for this proposed work was not necessary.

As mentioned above, this work was meant to be an exploration and a spotlight; it was not led by specific research questions. The main purpose was to highlight the history and evolution of SE3 through review of materials and conversations with SE3 leaders. Because of this, codes were not developed prior to review of the data but were emergent and intuitive. Internal validity or

credibility [2] was achieved not through triangulation in terms of peer examination, but through member checks. I shared a draft write-up with interlocutors and I received some feedback, including some objections to the history I told and aspects of my characterization of both engineering and the work of SE3. Some of these comments added more support for my interpretation. I also addressed concerns by conducting one follow-up interview to verify personal accounts, including intentions of people in leadership, and to get more feedback on my interpretation of the information I collected. I also removed contested details that were not critical to the argument.

A numeric analysis was not completed, analyzing discourse by counting how many times a phrase was used, for instance. Yet, in addition to triangulation through follow up with interlocuters, reliability or dependability/consistency was achieved through coding interviews using qualitative analysis software to verify the themes that I had identified were prevalent. I organized the information based on my knowledge of the profession and previous scholarship.

Because of this approach, researcher positionality is important for understanding how information was thematized and organized as my "intuitive" organization depends upon my past experience, my perspective, my values, or my standpoint as defined by Walter and Andersen (informed by researcher's epistemology, axiology, ontology, and social position.) [3][4]

First, I approach this work as a registered professional engineer, having worked in structural engineering from 2002 through 2017. The research topic is directly informed by my positionality (or my life experience, replete with various privileges as well as feelings of being an outsider). I did not participate in SE3 as an engineer, but I first learned about the work of the organization from an engineering colleague. Because of my own experience as a woman in engineering (which I have written about for an engineering audience [5][6]), I became interested in completing an ethnography to show invisible cultural forces that affect engineers (especially those who do not feel they "fit" into norms of their professional context). I contacted engineering colleagues about my ideas for this research and it was then that I learned about the new SEAONC committee of SE3. I spoke with several of the active members originally in 2017, not long after the original report had been published, and decided in 2022 to follow up on the efforts in a sustained exploration. The activist aims of my scholarship have significant overlaps with the aims of SE3 and this likely helped me gain access to be able to complete this research. My outside status as no longer a part of the engineering community also likely helped interlocutors feel at ease. My choice to share a draft write-up based on the research with research participants led to interesting feedback and additional information as some interlocutors affirmed the analysis and others took exception to some of the claims and representations.

Second, the theoretical framing for analysis of this qualitative data is informed by my academic training. After working full time for four years, earning my PE during that time, I left to enter graduate school, studying ethics, religion, and focusing ultimately on women's, gender, and queer studies. I continued to work in engineering part time remotely as a I completed my master's and PhD. My academic training is in humanities, but religion is an interdisciplinary field that allows for many methods, including ethnographic methods. For my dissertation, I undertook a qualitative study of Cambodian women who were leaders in their Buddhist and Christian religious communities, my work funded by a Fulbright award. My work always looks

for the underlying, unspoken values and the effects of these, my academic lens influenced especially by the work of queer theorists (e.g. Judith Butler), postcolonial thinkers (e.g. Gayatri Spivak), transnational feminists (e.g. Chandra Mohanty), and decolonial scholars (e.g. Maria Lugones). As referenced later in the paper, similarly theoretically-situated projects have been conducted by others in engineering education and engineering studies. Multiple studies have established common values within engineering which I show are also instantiated by my exploratory work with SE3. The relevance and prevalence of values I see in SE3 is also affirmed by my personal experience in engineering.

Introduction to SE3

SE3 was started by two women engineers who had seen a presentation reporting on a national survey about equity and talent retention within architecture by a committee in AIA (American Institute of Architects). [7] Inspired by this, the engineers approached SEAONC with a proposal and SE3 was established as an ad hoc committee in 2015 "to study engagement and equity in structural engineering in order to provide meaningful input on improving both of these metrics within the profession" [8]. The aim remains unchanged; the current SE3 website explains that SE3 was established "with the mission of improving engagement and equity in the structural engineering profession." [9] The first order of business was creating and widely distributing a survey (that had over 2,100 responses) [3],[4] to collect information that might affect retention. In terms of equity, gender was the focus with questions about race and sexuality introduced in later surveys. Subsequent SE3 programming focused on sharing the survey results, providing a mentorship program, developing a best practices guide, and undertaking follow-up analysis on pay disparities. Surveys have been distributed twice since (2018 and 2020) slightly modified to streamline the process. In 2017, SE3 was asked to establish a committee at the national level (at NCSEA), which mainly focused on the national survey creation, distribution, analysis, and write-ups. SE3 SEAONC became a local chapter and other regions created chapters. While the national committee helps share resources and connects the committees, the local chapters decide their own agendas. SE3 SEAONC, which I will refer to simply as SE3 for the remainder of this paper, continued programming based on the surveys, with a push in 2019 for awareness of Diversity, Equity, and Inclusion (DEI), with a symposium and new DEI Task Group, eventually adding a Racial Equity Task Group. Programming in the 2021-2022 year included a long-term mentoring program, a racial equity book club, and a DEI training for firm leaders. SE3 published results from a study of pressure points for people of color studying structural engineering by analyzing data from programs in California. From early 2022, SE3 increasingly focused programming on equity in design as well.

Hierarchy of knowledge – 'real' engineering

The consequences of perceived boundaries of 'real' engineering, which limit engineering to technical work, are evidenced in the accounts of the work and struggles of those in leadership positions of SE3. In her influential 2007 article, "Nuts and Bolts and People" [10], Faulkner wrote about the concept of 'real' engineering [11]. Here she expanded on the idea of a technical/social dualism and demonstrated how "Many engineers cleave to a technicist engineering identity, and even those who embrace the heterogeneous reality of their actual work oscillate between or straddle, not always comfortably, the two identities" [5]. While engineers must have social skills as well as technical skills, the association of engineering as technical remains prevalent. Cech and Waidzunas remind readers of the importance of having technical

prowess in order to be seen as a competent or good engineer: “This dualism is a central part of the engineering identity: to be considered a competent engineer requires ‘throwing oneself’ into technical activities” [12]. Faulkner and others, e.g. [13], [14], assert that this understanding of ‘real’ engineering is particularly impactful for women because of the common societal bias associating femininity with the realm of the social and masculinity with the realm of the technical. Cech and Waidzunas [7] assert that it is also particularly significant for lesbian, gay, and bisexual engineers, not only those who perform femininity but also because experiences of discrimination, based on their sexuality in this case, are not considered relevant or appropriate to be included in conversations about engineering and among engineers [7].

Among engineers who worked on the SE3 committee, I heard similar reports about how their firms viewed this committee work relative to work on technical committees (like the Seismology Committee or the Existing Building Committee), which work to develop codes, standards, or mitigation strategies using the latest developments in research. While those involved in SE3 noted the benefits that their involvement had to the career, they were not necessarily recognized in terms of advancement in their firms for this work.

Various interlocutors let me know that their work heading SE3 was valuable in terms of making connections with others and the work was well-regarded among others in the professional organization that shared the values of diversity, equity, and inclusion. For instance, one former chair who is in a management position at their firm explains:

> By people who don't dislike the mission of SE3, I feel like it's well regarded. I feel like it's been a really beneficial experience for me. I have reflected on [how] I focused a lot on that for many years, at the expense of like a technical committee, right? I could have been doing code development or seismology committee or whatever--more traditional and male-dominated committees or professional development activities. [There are] pros and cons for both paths, for sure. But I don't feel like people dismiss SE3. I feel like if anything, it's been gaining more and more notoriety over time.

This comes from an engineer who has advanced in their career and sees their work with SE3 as having been helpful in that advancement. Another less senior leader in SE3 asserted something similar about the benefits especially for new engineers who can join technical committees but don’t yet have the knowledge to contribute much to them:

> You still make a lot of connections in SEAONC and in the industry, because you're talking to people at events or organizing an event and trying to get people to show up. So, there's a definite benefit. You are still part of the SEAONC community at that point. Right. People will start to know who you are and that's a huge benefit.

Because it’s not just how well you do your calculations, how clearly and simply you design details, how easily you translate your work to both clients and contractors, it is also important to be active in the professional association to meet more people. These contacts can be useful in being future sources of information and help you to build rapport in the professional society which will increase your rapport in your own firm. But the volunteer work in the SE3 committee

is less likely to be considered in your annual reviews than work in other committees, for instance, because of the hierarchy of knowledges.

Interlocuters explained this in several ways. One of the leaders of SE3 explained their frustration with the expectations of the profession and the hierarchy of the technical over something more directly connected to social impact, like the work of SE3. They explained the typical path to gain respect or clout in structural engineering:

> And you have to spend a decade on the seismology committee and a decade writing code changes and all this stuff to be respected in the community. And I think that's one of my frustrations with it too--I guess you could say this is a cultural issue for the profession--is you're just gonna push people away.
>
> Cause I look at the younger generation like myself and we're not as interested in that. And so that's why you have an issue with people leaving the industry. They're just not interested as much in helping to develop the code. They'd rather be working with people and making an impact on people more directly.

This leader went on to explain that there is a social impact to code development but work that has a more direct social impact is more desirable for many people. Further, they saw a connection between structural engineering's focus on the technical work and inability to sustain a diverse workforce.

Another leader of SE3 emphasized the hierarchy at play. They explained that this committee work might be viewed by others as not "fancy" technical work, a word choice which seemed to be a tongue-in-cheek way of demonstrating how in the profession it's not as prestigious as updating codes or creating standards using the most recent research:

> You're not doing "fancy" technical work. personally [I] feel that on my work side of things that if I was on the existing buildings committee, maybe I could put my name on a paper by now. And then I could write that in [my preparation materials] for my end of the year review. But most of those things (measures for evaluation) are geared towards technical papers or technical presentations or technical whatever. So, yes, there's definitely a lot of people who would look at what we do and say, well, you're not advancing your engineering so why should we log it. And I think most of the people in our committee don't necessarily do it for that reason anyway. So it doesn't matter…

Here, you can clearly see "technical" as the top value and because this non-technical work in the field is viewed as not "advancing your engineering" because engineering (or 'real' engineering) is presumed to be defined as technical work. The work is not as generally prestigious as other professional service. This interlocuter also hinted at whether it would help them in an annual evaluation of their work which likely determines advancement. Interestingly, the last comment emphasizes that advancement is not the reason people serve on the committee. Over and again interlocutors emphasized the passion of those working on SE3, which is understandable but also leads to exploitation in terms of unpaid labor that's unevenly distributed. This phenomenon is not unrelated to a recent argument by Cech in *The Trouble With Passion* [15]. In particular,

Cech's assessment that people's inclination to prioritize following their passion "feeds into the culture of overwork, encouraging passionate professionals to tolerate contingent or underpaid employment and allowing employers to exploit workers' passion in the name of their bottom line." [10]. In the case of SE3, firms are not explicitly exploiting workers but because people are passionate about the work, they pour hours into work that does not lead to advancement and has an opportunity cost. The answer is, of course, not to extinguish the passion but to ensure that this labor motivated by passion is also recognized in terms of career advancement.

The problem is that engineers' work to make the profession more diverse and socially responsible is not adequately valued. It's not valued in the same way that technical work to advance the field or billable work is valued. Leaders of SE3 serve the profession, directly benefiting firms interested in these pursuits, offering their time for free. But compared with other professional service work, this likely has more negative career consequences for those who pour their time into the important work of SE3.

One former leader recollected the feeling of being taken advantage of during their time with SE3:

> It just felt like there were a lot of requests…"Oh, well, can you guys tell us how to do this?" And "tell us how to do all these different things" or "how do we improve our company?" And you're kind of like, we can set things up, here's the best practice guide, but also like we have full-time jobs. My job is not being your consultant and it kind of started to feel like we were being treated that way.

The "full-time job" that this engineer refers to is their billable work or work seen to lead directly to future work and revenue for their individual firm.

Another engineer explained that while most people don't do the work of SE3 to advance in their jobs, it was still unnerving that this non-technical work was not counted in annual reviews. Rather than recognition in terms of praise, they wanted recognition in terms of career advancement in their "real" job (the work that was compensated).

> I put in a lot of time—I put in just as much time as a chair of any of the technical committees so I would like…[in the annual evaluations] at my real job, I would like that to be weighted equally in a way. I know in the Bay Area where management is very supportive, and so they will say, you're the chair of a committee, it doesn't matter if it's not technical…

This interlocutor went on to explain how still in preparing materials for annual reviews there were prompts asking what technical presentations were given. They explained the problem:

> I gave a lot of non-technical presentations to a variety of audiences, but they don't really fit in this category. I guess it's exclusion by omission in some ways.

Again, the omission of non-technical professional activities from an annual evaluation standard shows again the hierarchy of technical activities within engineering. Another issue that can be

seen is what makes up these engineers' "real" jobs, or the work that is directly compensated. Firms similarly see real work as work that yields a profit.

Hierarchy of work – translating to profit

While culturally technical expertise is prioritized over social expertise (or so-called 'rigor' is valued over so-called 'soft skills'), profit is the most prominent value. As Brunhaver, Lutz, and Canney recognize, "[I]n reality, engineering practice has never been value-neutral, and capitalist, neoliberal values have been dominant, albeit taken-for-granted, aspects of engineering culture since at least World War II" [16]. Later they express this plainly in terms of profit: "industry goals are often driven by profitability, productivity, and benefits to the broader organization" [11]. Given the prominence of the value of profit, being able to translate work into profitability makes the work valued.

For most of the leaders of SE3, this was most consequential in terms of measuring their billable work which directly leads to profit for their firms. Engineers are expected to log a certain number of billable hours through different kinds of work on their various assigned projects. It is important for engineers to meet these expectations and the hours might even be quantified and compared with a rubric that determines promotions and advancement.

Not only is work with SE3 not technical but it is also not billable. So, labor that active members of SE3 spend on SE3 is labor that they cannot give to their projects. This cost was articulated by many leaders of SE3. The time spent on SE3 is time not spent on their day-to-day work, their "full-time job" as a leader who felt taken advantage of explained above. One SE3 leader explained that passion is a potential problem because it meant those active in SE3 spent so much time on their SE3 work:

> We've been really gifted to have people who are really passionate and taking it to another level. But the problem is, like I said before is just the people who are doing a lot of the work they're in every single committee. They're contributing a lot to every one of these initiatives because they're really passionate about it. And I have worries that they're not getting their own billable work done in a usual work week.

This shows the importance of billable work as opposed to time spent for professional activities, namely work on SE3.

One SE3 leader explained that when they see others in SE3 working to organize events or finalize publications, they can guess at the cost of this work in terms of career advancement. They explained this opportunity cost:

> So the dude sitting in the office next to me can work the same number of hours as me, but he gets paid for all of them. So yeah, that's the struggle.

Then they broke down the consequences of this for me. Because in some cases, the number of hours billed is directly considered in annual reviews and may be considered for several years at a time when assessing promotions, time given to SE3 (and lost to billable hours logged) could impact their path to advancement and especially the time it takes to advance.

Interestingly, one of the cohorts of firm leaders who participated in the SE3 program for Firm Leaders DEI Cohorts, gestured at problem of DEI work not counting as billable work, stating in the summary report that one of the barriers was this, "Commitment to non-billable work like DEI takes clear strategic direction from leadership."[17] A fix for the incentivizing non-billable DEI work—like giving it its own value in performance reviews—is not offered in this brief summary report and it is unclear if the firm leaders understand the problem entirely from the perspective of those being reviewed. Yet the summary report shows firm leaders have some recognition of the problem that several engineers articulated in terms of negative consequences of spending so much time on SE3 work because it was not billable engineering work.

Being able to translate work to profit is difficult for firms to do as many have a difficult time recognizing how work to diversify the profession and change the culture of the field leads to profitability. The case has long been made that a diversity of workers is beneficial for the bottom line and yet the calculus is not simple. This has real consequences for people working on initiatives like SE3. One SE3 leader who has been involved many years explained this:

> I guess one last thing I wanted to say is this work, I feel so passionate about it sometimes and it it's been such a big part of my life these last seven years, but there's been times of struggle where I can only give so much to it because of the volunteer work. And lately there's been times where if I'm struggling with something in my career, I do sometimes think about all the energy and time that I poured into this. If I had spent it on straight engineering, whether I would be at a different place in my career right now. And I certainly feel like that could be the case with a lot of people who are working in this space. We're so passionate about it because we want to improve the world around us and we have direct impact on the engineering workforce and the culture and the places that we work. But the time and energy I have invested in it has certainly, I think without question, taken away from time I could have been developing practical skills: improving project management skills or [developing] client relationships. It was a trade-off, and I did it and I think I would do it again the same way, but I know that there was a trade-off there.

This interlocutor, interestingly, sees their work with SE3 as distinct from "straight engineering." Their unpaid labor that benefits the profession and their particular firm is not developing "practical skills" of "project management" or strengthening "client relationships." This interlocutor recognizes their volunteer work benefits their workplace explaining, "we have a direct impact on the engineering workforce, the culture, and the places that we work." But later in the conversation this person explained that it's not really recognized by the current business model of structural engineering firms or counted in terms of individuals' advancement. They explain:

> It's hard to quantify the value you bring to an organization when you're shedding light on these types of issues. I think nowadays savvy business leaders come to recognize that it's very important to have people in your organization who are capable of engaging, mentoring, training other staff, who care about the workplace. And not only doing the work for the right money…but also building a positive environment around them. I think

> that business leaders are recognizing that, but it's hard to quantify that when it comes time to evaluate people's performance.

This important insight demonstrates the detriment to engineers who undertake the work of SE3. It's detrimental because it hinders advancement not because of malicious intent but instead because it is labor that typically goes unrecognized and uncounted in reviews.

Effect on SE3 Leaders

While this SE3 leader continues to work on engagement and equity within the profession, one of the problems for realizing the aims of SE3 (for instance, to improve the diversity, equity, and inclusion in the field and social equity through design) spawn from the extra burden placed on those doing the work of the committee. Various leaders spoke about burnout, which is a direct result of doing this extra work. While few left the field entirely (although at least one engineer in leadership has), others had become somewhat disconnected or had to really limit their involvement. This is bad for the people who are leading and bad for realization of organizational goals.

Implications for Research, Teaching, and Service in Engineering

This phenomenon is in many ways similar to the concept of invisible labor performed by faculty from underrepresented populations. This concept of invisible labor "consists of student-initiated mentorship, in which faculty provide 'hands-on attention' to 'service as role models, mentors, and even surrogate parents' and engage in caregiving and emotional work, especially pertaining to diversification and inclusion" [18]. It includes "student and faculty mentoring; department work not formally recognized or adequately compensated; emotional labor; work on curricular innovation and interdisciplinary projects; and work toward diversity, equity, and inclusion" [19]. It is called invisible labor because it is "neither rewarded nor recognized in merit reviews" [13].

Much has been written about the labor expected of and performed especially by people of color as well as white women but the concept applies to others that are not well-represented among a faculty, faculty who are minorities in terms of race, gender, sexuality, and any number of social identity markers. Taking on service work like mentoring can hinder advancement in academia, as it takes time from one's research and publication output. As opposed to service, publication output is measured and a robust record of research and publications is required for faculty to gain tenure and then the title of full professor. Despite common advice to say not to extra service work, within academia "women faculty and faculty of color in particular say yes because they are pressured to say yes, because there are hidden consequences to saying no, and because saying yes can bring important personal and institutional benefits" [13]. Minority faculty members explain their experience, how they remember looking for mentorship from someone who looked like them and in turn want to support their students directly as well as improve the institution's ability to serve these students through their committee work [20]. In many ways, this conundrum faced by faculty sounds similar to that articulated by engineers who have been active in SE3.

The explanation of the invisibility of this labor is similar to the invisibility of the labor for SE3. Akin to what might be viewed as a two-tiered system of work in engineering (of technical and social), in academia this service work "is rendered as secondary academic care work in the "two-tiered system of academic labor" (Cardozo, 2017, p. 409)" [13].

As the burdens of invisible labor are more prominent among those who are in the minority within academia (e.g. women, people of color, etc.), I was told in one interview that unsurprisingly SE3 was not representative of the profession (but that, for instance, people in the minority within structural engineering like women and people of color were overrepresented in SE3). Like in the academy, these are the people, then, who are burdened by the extra work that goes unrecognized in reviews. This is harmful for the individuals but also for the efforts of the work to diversify structural engineering and make it more socially equitable.

The solution given by those writing about the invisible labor that faculty perform is not to avoid this work. Reid writes, "rather than suggesting that faculty avoid this work, departments should offer credit for it" [12]. What matters is that in work evaluations, be they annual reviews in industry or tenure reviews in academia, work for diversity, equity, inclusion, and justice is recognized and counted toward promotions, in terms of both titles and compensation.

When considering the case of SE3 specifically, the easiest way to address the burden would be for firms to change the terms of review so that all professional activities, like this work on a non-technical committee, are considered in annual reviews. This could be done in conjunction with finding ways to translate this work to profitability of the firm. This does not necessarily mean paying active members and leaders of SE3 for their efforts directly, but it does mean recognizing this work as valuable, and work on these initiatives as important achievements that lead to advancement or promotion.

Another path would entail questioning maximizing profit as the ultimate value. This may or may not be a real possibility for fields like structural engineering. In my own experience, I distinctly remember a rather progressive manager who identified as a socialist say something to the effect of 'we are not a charity, we are here to make a profit.' Neither did any of my interlocutors suggest that a focus on profit was problematic. Instead, those who had served in SE3 often recognized the need for profitability and tried to address these concerns and frame their work in terms of a temporary dip in profit until the practice was familiar and widespread (when discussing designing to a higher standard for low-income/transitional housing to give residents that increased stability, for instance) or even appealed to the value added by their work. For example, several SE3 leaders explained that originally they needed to make "a business case for diversity."

Yet in a different conversation, one SE3 leader explained that culture of SEAONC is changing and despite pushback there is a cohort that believes political issues are relevant. Perhaps a value like social equity can rise to the level of the value of profitability in the hierarchy of values for a firm. This problem might be mitigated by firms honestly articulating their current values, including what they consider a self-evident top value, and exploring the possibility of adopting other values and augmenting their significance.

This is one way to address the negative impact of the hierarchy of types of knowledge and work within structural engineering, a hierarchy that has been affirmed in various engineering contexts. Importantly, the paper demonstrates how these hierarchies have deleterious effects for people working on increasing diversity and making the field more socially responsible. The paper

suggests that recognizing the importance of these contributions is a critical step to supporting and realizing the goals of diversity, equity, inclusion, and justice.

References and Notes

[1] Another way that the hierarchy of knowledge which prioritized knowledge gained by analysis of numbers and above knowledge gained in other ways is in the methods by which SE3 has approached improving engagement and equity. Elsewhere, I write about how SE3 has demonstrated the hierarchy that we see of technical over social and data analysis over other kinds of knowledge production. This is apparent in the committee's first action to gather data and analyze it, through surveys and quantitative analysis, and appealing to this data continues to be prevalent.

[2] S.B. Merriam and E.J. Tisdell, "Chapter Nine: Dealing with Validity, Reliability, and Ethics," *Qualitative Research: A Guide to Design and Implementation*, pp. 209-235, United States: John Wiley & Sons, Incorporated, 2015.

[3] Here I am referencing aspects of methodology (framework) for research (the focus of the book being quantitative but equally important to consider using qualitative methods) as articulated in *Indigenous Statistics:*
M. Walter and C. Andersen, I*ndigenous Statistic: A Quantitative Research Methodology.* [Online]. London: Routledge, 2016.

[4] This is similar to the dimensions of positionality (research questions, epistemology, ontology, methodology, researcher-as-instrument, communication) articulated by Secules et al. in their article:
S. Secules, C. McCall, J. A. Mejia, C. Beebe, A. S. Masters, M. L. Sánchez-Peña, and M. Svyantek, "Positionality practices and dimensions of impact on equity research: A Collaborative inquiry and call to the community," *Journal of Engineering Education*, vol. 110, no. 1, pp. 19-43, 2021, doi: 10.1002/jee.20377.

[5] L. K. Schubert, "The Invisible Gendered Culture of Engineering," *Structure*, Feb. 2013, p. 42*,* Available http://www.structuremag.org/?p=988

[6] L. K. Schubert, "Consequences of the Gendered Culture of Engineering," *Structure*, Apr. 2013, p. 66, Available http://www.structuremag.org/?p=745

[7] The effort within AIA was at the time called "The Missing 32%" and is now known as "Equity by Design [EQxD]." The Equity by Design website explains "In early 2014, the group conducted its first national survey on Equity in Architecture and talent retention. The survey received 2289 responses from across the United States. On October 18, 2014, the Equity by Design committee hosted the 3rd sold-out symposium titled: Equity by Design: Knowledge, Discussion, Action. 250 attendees traveled from all over the United States for the launch of the early findings of the Equity in Architecture Survey and participate in interactive break-out sessions in the three major knowledge areas: Hiring &

Retention, Growth & Development, Meaning & Influence." The parallels to the SE3 are striking.
Equity by Design [EQxD]. "Origins." eqxdesign.com [EQxD] Available: http://eqxdesign.com/origins (accessed: Feb. 22, 2023).

[8] A. Sommer, (Lead Author), "2016 Survey Report," Structural Engineering Engagement and Equity Committee of the Structural Engineers Association of Northern California, December 2016. Accessed: Feb. 22, 2023. [Online]. Available: https://www.se3committee.com/_files/ugd/9158d2_0bfbb0cc6f8741c693125b4e22948b39.pdf

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