

# **The Efficiency-Inclusion Dilemma: Reproducing Dominance Hierarchies through Efficiency Logics in Semiconductor Engineering**

**Sarah Appelhans**

Sarah Appelhans is a postdoctoral research assistant at Bucknell University. She earned her PhD in Cultural Anthropology at the University at Albany (SUNY). Her dissertation research, "Flexible Lives on Engineering's Bleeding Edge: Gender, Migration and Belonging in Semiconductor Manufacturing", investigates the intersections of gender, race/ethnicity, and immigration status among semiconductor engineers. She is currently the resident social scientist in the Electrical Engineering Department at Bucknell, exploring how to teach convergent (deeply interdisciplinary) problems to undergraduate engineers. Past research projects include studies of governance in engineering education and the influence of educational technology on engineering education.

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## **Abstract**

This study explores the relationship between inclusion and efficiency in engineering culture. Prior research has indicated that the masculine-dominant and exclusionary cultures within engineering have contributed to attrition of women and minorities from the field. In particular, cultural values such as rigor and meritocracy are mechanisms through which the discipline remains predominantly white and male. In this paper, drawing upon ethnographic fieldwork amongst engineers in the semiconductor industry, I suggest that another such mechanism is the cultural value of efficiency. Productivity and efficiency are mindsets cultivated in contemporary workplaces that justify and enable the pursuit of narrow self-interest by offloading work that is culturally determined to be “unimportant” or “nonurgent”. Engineers, with their disciplinary preference to simplify, narrow, and streamline processes, are particularly persuadable by efficiency logics. Inclusion work, however, demands a relationship of care that is undermined by the individualist logic of efficiency, contributing to women’s and minorities’ experiences of isolation and nonbelonging in the discipline. In order to improve women and minorities’ experiences in engineering, I argue that we must reimagine workplace efficiency to include actions of care as necessary and important elements of an inclusive engineering culture.

## **Who Does the “Garbage Work”?**

Lifen (F, 29, China) is overdue for a promotion. She has been recommended by her manager to be promoted twice now, but her request keeps being postponed until the next year. Her manager explains that she is simply not getting enough “visibility” and other candidates are promoted first. Lifen understands why she needs visibility, but she keeps getting dumped what she refers to as “garbage work” that prevents her from doing more high-priority projects. As an engineer in a manufacturing role, when the production process stops, it is part of her team’s job to troubleshoot the problem. “It’s stupid work,” she complains. “It’s the same work, every day. It’s not difficult. Just everyday maintenance work.” Although she would like to spend more time on higher-visibility projects, she keeps getting pulled back into mundane daily maintenance.

“[My small team leader] told me he doesn’t like all the garbage work. The reason why he keeps [this assignment] is for job security. For the team. He said this one can give us a lot of job security, so we have to keep it. Then I asked him, you want to keep [it] but you don’t do it? He doesn’t answer...”

The small team leader is trying to protect the team from downsizing by taking on mundane tasks that no other teams like to do. However, given that the work is low visibility, no one wants to do it themselves, so it is diverted to the most marginalized employees.

This was a common experience amongst women working in semiconductor engineering. Although they knew they should be spending more time on “high visibility” projects that would count toward their promotions, somehow they always ended up doing the work that no one else wanted to do – either the maintenance work described by Lifen, or community work, such as

organizing speakers and coordinating between teams. This work is incredibly important for the company, but doesn't count much toward individual career progress.

According to productivity logics, this is actually how it is *supposed* to work. Media studies scholar Melissa Gregg [1], in her analysis of self-help literature, points out that people seeking career success are encouraged to identify the types of work that are most important and eliminate non-essential tasks or delegate them to others. The small team leader is doing what he knows is necessary for his own career progress. The central tension in this story, however, arrives when we consider those to whom the non-essential tasks are delegated, the ability of those individuals to resist or otherwise exercise agency in response, and the ways that this process contributes to persistent inequalities of gender and race/ethnicity.

## Literature Review

Over the decades, countless studies have been conducted to understand how the engineering profession remains so stubbornly white and male-dominated. Although other scientific disciplines have made significant progress toward inclusion of women and minorities, engineering workplace demographics remain the lowest of all scientific disciplines: only 16.1% women, 16.4% Asian, 8.3% Hispanic/Latino and 3.6% Black/African American in 2019 [2]. Social theorist Pierre Bourdieu [3] theorizes that because cultures are constantly in a state of change, wherever we find cultural stasis, it must be because norms are being consistently reproduced by the population to give the appearance of permanence and inevitability (he calls these processes *dehistoricization* and *eternalization*). This paper therefore takes particular interest in studies of engineering culture and the cultural norms and practices that reproduce white and masculine dominance despite the numerous interventions since the 1960s Civil Rights Movement.

Prior research in engineering education reveals that cultural values of “rigor”, “meritocracy”, and “depoliticization” are utilized to resist the types of structural change that would make it easier for minority engineers to succeed. Engineering departments oppose efforts to expand admissions on the basis that it lowers rigorous standards of excellence [4], [5]. Similarly, diversity efforts, affirmative action, and social justice are accused of undermining meritocracy by giving preferential treatment to minority groups. Meritocracy's proponents argue that everyone should compete per the same standards; meanwhile, attempts to point out that existing processes in engineering are not meritocratic are dismissed as too political [6]. Cultural ideologies such as these – rigor, meritocracy and depoliticization – are deeply held by the engineering community. When embedded in structures such as admissions and promotion, these principles make inequalities seem logical, and even just, and as such, have contributed to the continued predominance of white men in the discipline and exclusion of women and minorities.

In this paper, I highlight an additional ideological commitment that engineers have a particular affinity for: efficiency. In my anthropological observations of the men and women working in semiconductor engineering, I was struck by the hyper-organization and planning that permeated engineers' work and home lives. This is perhaps not surprising. Engineers' role in manufacturing is to evaluate and streamline processes, improve workflows, increase production speed, and eliminate waste. The Mann Report of 1918 [7] argued forcefully that “many of the burning questions of the time” lay in the field of scientific management and forecasted that it would become a central goal of the engineering profession to develop expertise in finding time and labor efficiencies in business. It makes sense that engineers would extend these practices into their own work habits and personal lives.

Over time, responsibility for the discovery of labor efficiencies has been transferred from corporations to individuals and has become infused with a fixation on individual efficiency, commonly referred to as productivity. Indeed, for the purposes of this paper, I will use productivity and efficiency as synonyms, as both are concerned with maximizing output and minimizing costs. Productivity is essentially the scientific management of the self, internalized to achieve greater personal efficiencies.

Gregg argues that personal productivity strategies implicitly demand that “successful employees” view other employees as less important than themselves, offloading “unimportant” or “nonurgent” tasks onto others [1], a strategy recommended in Stephen Covey’s *7 Habits of Highly Effective People* [8]. Among this “unimportant/nonurgent” work includes the “social” and “collaborative” tasks that may be perceived as inefficient. Furthermore, “unimportant” work is implicitly gendered and racialized. Women carry additional expectations for emotional labor at work, which is often “unimportant” but impossible to refuse without being perceived as “angry” or “cold” [9], [10]. Similarly, women of color are routinely tasked with “diversity work”, which takes time away from work that counts as productive labor. In academic settings, Black women’s substantial contributions to service work (whether voluntary or mandated) have been characterized as “academic housekeeping” [11]–[13], which detracts from their ability to produce publications that count toward tenure and their broader academic legacy.

In this paper, I will explore how personal efficiencies are wielded in the engineering workplace and how they contribute to the reproduction of inequalities in the discipline. What conclusions might we draw about engineering cultures, their proclivity toward efficiency, and the role of efficiency logics in the reproduction of inequalities more broadly?

## Methods

Fieldwork for this study took place from June 2018 to August 2019 amongst semiconductor engineers in a small semiconductor manufacturing hub in the Northeastern United States. Given the difficulties in being granted full access for corporate ethnography, I instead utilized “polymorphous engagement” [14], triangulating information from a variety of sources in the region. Over the duration of the research, I conducted 38 life history interviews with semiconductor engineers (14 men, 24 women, ages 23-56) and selected 17 families to follow up with multiple times throughout the year (approx. 85 total visits), either in their homes or over their lunch breaks. Due in part to the heavy recruitment of immigrant engineers in semiconductors, my sample was racially and ethnically diverse, hailing from 11 nations, speaking 13 different native languages.

The value of ethnographic research lies in its ability to richly describe the complexities of culture, connecting the minutiae of everyday life with the broader social forces that shape our existence; anthropologist Clifford Geertz famously termed this phenomenon “thick description” [15]. “Small N”, targeted, qualitative studies are particularly suited for studying minority populations and inequalities [16]. Although qualitative studies with small sample sizes can never be representative, they clarify nuances that may be missed by larger studies [17]. Indeed, the complexities captured by qualitative research can be particularly useful when crafting larger quantitative studies [18]. Furthermore, by narrowly focusing on specific populations in particular regions, we can isolate important contextual variables. For example, by studying semiconductor engineers in the Northeast, we can discern how semiconductor engineering differs from biomedical or manufacturing environments, or how high-tech culture in the Northeast differs

from Silicon Valley. Therefore, although engineers typically have affinities for quantitative data, qualitative data can be a useful tool for identifying productive areas of study.

### **Efficiency Logics in the Workplace**

Characterizations of “efficient” work practices are culturally determined, meaning they will not be the same in all places; rather, each company, each discipline, each cultural subgroup will have alternate definitions of what kinds of work are deemed “important”. Still, it is possible to discern a normative definition, which is often marked by its association with power. Which definitions are supported and rewarded by individuals who wield power in the organization?

In the opening vignette, I described one such example – siphoning low priority work onto marginalized employees, in an effort to prioritize one’s own time for “high visibility” projects. I will discuss one more common practice in the semiconductor industry that disadvantages women and minority engineers: a reluctance to meet with junior employees.

Mandira (F, 35, India) has struggled with a coworker of hers who persistently refuses to attend her meetings. “He would send me an email, ‘I don’t know what you’re doing in this meeting, I don’t get this and that,’ and he gets really upset. And I’m like, ‘Why does he feel that?’” Lifen, from the opening vignette, has also experienced this problem. For one of her high visibility projects, she needed another team’s help to develop some parameters for a device and send them to the manufacturing floor. Because the other team did not directly benefit, they decided not to bother to attend the meetings. It came as a shock to Lifen when she discovered that the key people she needed were not present. She was unable to move her high priority work forward until they cooperated.

Michael (M, 56, White American), a senior technical engineer, tells me that it is common for engineers to decline meetings with junior employees. While anyone can request a meeting, junior employees have a harder time getting people to show up. One of his younger team members from Singapore faced this problem recently. After several no-shows from key people from other teams, Michael’s boss told him that he, as the more senior employee, needed to call the meetings from now on so that people would actually attend.

The discourse of productivity resonates in these examples, as upper level employees justify not attending meetings by reasoning that meetings called by junior employees are not important enough to merit their attention. It requires the weight of a more senior engineer to justify investing time into another team’s work. By focusing their attention solely on the projects and meetings that are directly beneficial to themselves and their own teams, they are following common productivity advice to refuse to allow others to disrupt their schedules for less important work. Gregg argues that this advice creates a permission structure for ignoring the needs of others, essentially offloading “the inconvenience of other people” [1, p. 91] in order to focus fully on their own high priority work.

Furthermore, refusals in the name of personal efficiency are supported by power relations that make it possible for some employees to refuse but impossible for others. The question of who will do the work that has been refused is often not considered. In the examples above, it is not only the junior status of the employees that justifies their poor treatment, although that is often the way it is perceived. The fact that these employees are women and immigrants, who have less ability to refuse the work that has been offloaded onto them, and less able to insist on meeting attendance, is also a significant contributing factor.

## **Alternative Definitions of Efficiency**

Although the previous examples describe normative practices of personal efficiency logics, no culture is ever entirely homogenous and alternative definitions of efficiency exist in the semiconductor workplace. I will focus here on one significant deviation that takes a wider view of efficiency, which I heard most frequently from women and minority engineers. I will argue that extending the definitions of “efficiency” to include the community work described below, could have a significant impact on creating inclusive workplace cultures. This by necessity requires setting aside strictly individualist notions of efficiency and shifting to community-based measures.

Vidya (F, 44, Indian American) strongly feels that the “low visibility” work she does for other teams is valuable to the company, even though it is not visible to her managers. Therefore, in addition to her efforts to move her high-visibility projects forward, she also deliberately sets aside time to coordinate with other teams, helping them craft their presentations and tweak their arguments. Tasks like these strengthen the workplace as a community and involve longer-term calculations of value. Although Vidya does not expect her managers to reward her personally for these efforts, she believes that cooperation between teams helps keep the company from duplicating efforts or missing important information.

Jennifer Mallette [19] has observed similar long-term efficiency preferences amongst women engineers in their technical writing. Many engineers, Mallette reports, will do only the bare minimum on non-essential tasks, such as writing, investing minimal time on these tasks and then refocusing their efforts on more high-impact work that is directly beneficial to their own immediate success. Mallette borrows a term from economics to describe this phenomenon: satisficing [19]. She finds that men are generally more comfortable satisficing than women. In contrast, women take a wider view of efficiency and success, including calculations that recognize how large investments of time up front save time later in the product cycle. This is Vidya’s argument: the work she does makes the company more productive and cooperative in the long run, but is less tied to a direct, measurable, short-term achievement.

## **Tolerating Bumpiness**

Efficiency practices, such as those described above, are designed to smooth our own schedules so there is little friction on our path to success. However, feminist theorist Sara Ahmed [20] warns us to be wary of smoothness. Smoothness is often the result of papering over discrimination. Reminders of inequality are bumpy, they generate conflict. Ahmed implores us to embrace bumpiness as a core tenant of equity work, and to reduce our expectations of smoothness [20].

From my own experience as a white woman conducting this study with immigrant families in semiconductors, I have learned that inclusion work is about learning to tolerate more bumpiness in my life, more uncertainty, more situations in which I am uncomfortable. In the process of getting to know my research participants, I asked questions about their cultural background, their families, and their goals for their lives. I invested time in getting to know them, spent hours over coffee, rearranged my schedule to accommodate theirs. These kinds of conversations are difficult to have in the workplace since “efficient” hallway conversations are strictly work-related. The work of inclusion requires that individuals from dominant groups go out of their way – to interrupt their own carefully planned, efficient workdays - to connect with coworkers from minority backgrounds.

I suggest that part of the reason why engineering has remained so closed to marginalized outsiders is because their cultural commitments to efficiency prevent them from providing the kind of care needed to sustain an inclusive community. This kind of care work is often discounted as nonessential and superficial, regarded as “chit-chat” or “fluff”. In the process of smoothing their schedules, engineers eliminate so much “garbage work” and social interaction that they do not notice how much work has been offloaded onto others, or recognize how this contributes to the suffering of their marginalized colleagues.

Feminist theorist bell hooks reminds that a central component of feminist work is to raise our own consciousness and reflect on the ways that we each benefit from patriarchy [21]. As such, we must begin to consider how our own preferences for “smoothness” results in additional work and suffering for others. Additionally, what kinds of “inclusion work” are eliminated because they are presumed to be “inefficient”? If we reframe efficiency as occurring at the community level, as opposed to the individual level, many “inclusion” activities can be justified as contributing to the long-term efficiency of the group.

However, in many cases, hooks maintains that doing feminist work will require rejecting the privileges granted by intersections of whiteness, maleness, and wealth [21]. As such, employees may need to stop playing by the accepted rules of career success, choosing to reject individual advancement when it requires practices that contribute to the marginalization of others. In practice, this may look like deliberately scheduling time to spend with junior employees on projects that advance their careers, or accepting more “garbage work” oneself so that marginalized coworkers do not have to absorb so much of it. These will result in reduced personal efficiency, but may ultimately help level the playing field for women and minorities in engineering.

## **Conclusion**

I have argued in this paper that efficiency is a core value in engineering that contributes to the perpetuation of inequalities in engineering. Through my work with semiconductor engineers, I observed that my participants enthusiastically adopted scientific management principles in the management of their personal lives, following popular productivity advice. I showed how the application of these principles in the workplace places minority engineers at a disadvantage. The permission structures created by productivity discourse justify the offloading of unimportant work to lesser status employees and the reluctance to invest time in the high priority work of junior employees. When coupled with gendered and racialized dynamics in the workplace, it becomes clear that women and minority employees have a reduced ability to refuse “garbage work” or demand participation in their high priority projects due to stereotypes that they are “angry” or “emotional”. This creates a structure in which it is difficult for minority engineers to compete on the “high visibility” promotion track.

However, there exist alternative definitions of efficiency in engineering culture, wherein longer-term calculations of value justify the investment of time in community work. By embracing this broader view of efficiency, engineers can justify spending time on activities to strengthen inclusive communities. This cultural shift would require a reconsideration of company values, which should be supported by policies that reward community-building activities and the care work that supports inclusion. Still better, promotion structures could be reoriented to reward community success, rather than individual success, decreasing the incentives to privilege one’s own work over the success of the team. Cultural change is one of the most difficult aspects of inclusion, but it is also the most fundamental lever of change that reverberates in every corner of

the organization. By shifting to a community-based form of efficiency, organizations can make great strides toward reducing the incentive structures that justify, and even reward, the second-class treatment of minority employees.

However, given that cultural change is difficult, there is additional work that we can do as individuals to implement feminist principles in our everyday lives by detaching from our own expectations that our lives should be perfectly efficient. We must recognize the privilege inherent in demands for the ability to fully focus on our own high priority work, without interruptions or delays. Instead, as Ahmed [20] suggests, to live our feminist principles, we should embrace more bumpiness, understanding that conflict is a requirement of the fight for equity. We can make time in our schedules to support the high priority work of others. We can accept more of the “garbage work” ourselves in order to avoid overburdening women and people of color. We can recognize that while these efforts may require sacrifices regarding our own personal success, it strengthens the possibilities for a more equitable future.

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