

Using a Values Lens to Examine Engineers' Workplace Experiences

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Introduction

The development of a skilled and robust U.S. engineering workforce is more crucial than ever as numerous social, environmental, and health crises unravel on a national and global stage [1]. Yet, productivity and retention remain prominent concerns for the engineering profession [2] [3]. Studies have addressed these issues by focusing on the persistence of a “skills and knowledge” gap, noting how engineers’ preparation fall short on central aspects of professional practice such as teamwork, communication, and information-seeking [4]-[8]. While these studies suggest that enhancing engineers’ technical and professional competencies can increase their self-reliance, thereby increasing their job performance and satisfaction, accounts of under-preparedness continue to surface.

Correspondingly, emerging research by the current author team and others suggests that gaps in what engineers know and can do are not the sole sources of confusion as they transition from students to professionals, and person-organizational value congruence is likely just as important in shaping engineers’ experiences within their organizations [9]-[12]. For example, in a prior paper, we shared the story of Philip, a relatively early-career engineer struggling to balance his professional obligations to his company and his strong feelings of social and ethical responsibility toward the public [9]. And recent prominent examples of engineers grappling with value incongruence have occurred at multiple high-tech companies over issues that personal security, warfare technology development, worker safety, and climate change [13]-[19], among others. In each case, tensions arose very publicly between engineers and corporate leadership over disagreement centered on values. However, the aforementioned literature on engineers’ work experiences suggests that both major and minor instances of value incongruence play out in the engineering workplace often, in myriad ways.

Value congruence correlates with better work outcomes at all levels, including greater work satisfaction, psychological well-being, health, and performance of the employee [20] [21], more open trust and communication within work units [20] [22] and better productivity, innovation, and retention for employers [20] [23]. It may be surprising, then, that undergraduate engineering education has not focused on values learning in the same way it has on addressing other “skills and knowledge gaps” such as those in technical, professional, or organizational areas. Much like current efforts to “close the gaps” have focused on dismantling the social-technical dualism by highlighting the importance of social skills and contexts within engineering [24]-[26], similar efforts are needed to erase the depersonalization of engineering work and the understanding of engineering education as training “ideal workers” [27] devoid of their own personal values on the job.

This position paper argues that it is important to explore the role of personal and organizational values and culture and the tensions that exist between the two in engineering education and practice. Specifically, we critically examine findings from our own work, previously published research on practicing engineers, and examples from contemporary media, applying the lens of “values gaps” to explore engineers’ professional experiences and the tensions that occur in new light. Our central thesis is that interventions to improve engineers’ preparation for the workforce will be sufficient only when scholars also consider the differences in values between individuals

and their employers. Whereas it might not be possible or practical to completely eliminate the gaps in engineers' skills noted by the literature, a focus on values could better position engineers to successfully transition from school to work, authentically find their own path within engineering, and meaningfully contribute to engineering organizations and society.

Motivation and Background

Productivity growth in the U.S. continues to struggle [2], the nation's educational attainment and academic achievement rates trail behind those of other world leaders [28], and the U.S. is projected to be short 1 million STEM workers by 2025 [29]. The nation needs greater engineering capacity to increase its global competitiveness and innovativeness and protect its national security, public health, and infrastructure [30] [31]. Yet, complaints of engineers' under-preparedness continue to grow even as more calls for a more skilled and robust engineering workforce surface across industry and academia. There is thus a need for deeper investigation of the challenges that engineers encounter in the workforce, including the gaps they see between their organization's values and their own. This need is also more important than ever, as the most recent engineering graduates to enter the workforce belong to a generation that currently reports the largest value incongruence with their employers and the highest intentions to quit their job over value incongruence [32].

Despite little direct study on the topic, examples of value incongruence in engineering can be found in the literature [9]-[12]. Ethnographic fieldwork has demonstrated how engineering organizations exert normative control over their members' beliefs and values by reifying "strong culture" [33]-[34], or dominant narratives that unduly influence members' modes of participation. These narratives promote enhanced flexibility, structural ambiguity, and looser supervision in exchange for becoming an "ideal worker" and demonstrating organizational fealty [33]-[34]. This perspective assumes that each worker can and should devote the same amount of attention to work and achieve the same productivity and satisfaction levels as everyone else [27] [35] and implicitly encourages behaviors that lead to negative individual outcomes (e.g., intragroup competition, burnout). As a result, engineers can develop a "sociological ambivalence" (mixed feelings) about the balance between autonomy and support in their organizations [33]. Recent graduates might acutely feel this ambivalence, as they tend to report wanting more structure and guidance from organizational leadership [36] [37].

While better attention to value congruence within organizations could help increase address these issues, undergraduate engineering education might also be contributing to value incongruence as students transition to engineering careers. Engineering school and practice espouse different values reflected in their respective cultures [38] [39]. For example, where academic goals emphasize student learning and development, industry goals are often driven by profitability, productivity, and benefits to the broader organization. Many students thus graduate with uncertainty about what working in an engineering organization is like [40]. Some might extrapolate from real-world jobs, internships, or co-ops [41] [42], but not all students have access to these opportunities, especially if they come from minoritized groups or have less social and cultural capital [43] [44]. Further, engineering education has been criticized for perpetuating a "culture of disengagement" [24] that privileges objectivity and, in the process, eschews discussions about values or relegates them to conversations about ethics and personal

responsibility [45]. Therefore, recent graduates might feel ill-equipped to negotiate the differences between their personal and organizational values if they even have the option.

By making issues of values more visible for both engineers and organizations, we can more fully understand the different challenges faced by emerging engineering professionals as they transition from students to professionals in practice. This can, in turn, give researchers and educators a language with which to describe relevant values and therefore offer strategies for navigating these “values gaps.” One potential result of this focus is engineers who are more fulfilled and engaged with their workplaces, which can positively affect productivity, commitment, and performance [20].

Theoretical Framework

Within engineering education, the role of values remains relatively underexplored (perhaps because engineering culture often positions itself as free of values or biases), but outside of engineering education, examining these issues is not new. Researchers in social and organizational psychology have examined values through numerous approaches and frameworks, e.g., [46]-[49]. For this study, we turn to Schwartz et al.’s values framework [50] [51], which we leverage due to its seminal and popular nature and proven utility in understanding how values influence behaviors and priorities in a range of domains (e.g., workplaces [51] [52]). While Schwartz et al.’s [51] model has evolved and been refined over time, the most recent iteration presents values in terms of the four overarching themes and nine sub-themes shown in Table 1. Notably, each of these values exists on a continuum and can take on different levels of centrality and significance for different individuals. Taken together, the values in the Schwartz et al. model can form a comprehensive picture of both the range of values and the degree to which they matter for a given individual. In the following sections, we present examples of how Schwartzian values can be used as an interpretive lens in existing scholarship, followed by potentially fruitful applications of the framework in future engineering education research and practice.

Table 1: Schwartz et al.’s four value dimensions [51]

Value	Definition
Openness to change	The importance of having autonomy and control over one’s thought, action, and feeling; includes self-direction and stimulation
Conservation	The importance of following rules, resisting change, and preserving the past; includes conformity, security, and tradition
Self-enhancement	The importance of ambition, success, and recognition for various accomplishments; includes achievement and power (dominance, resources)
Self-transcendence	The importance of protecting others and the natural environment; includes universalism (concern, tolerance) and benevolence (dependability, caring)

Framing Engineers’ Professional Challenges via Values Gaps

Our position in this piece is that it is important to consider values-based theories and models in engineering contexts because current research has overlooked how values play a role in the experience and formation of engineering professionals. To support our position, we leverage existing examples from current literature in engineering education and contemporary issues in news and media more broadly to demonstrate how a “values lens” could be applied for additional insight and understanding. We examine engineers’ interactions with their organization due to the

organization supporting or suppressing the expression of particular values and note how these interactions appear to influence the engineer's experiences.

Revisiting and Reframing Existing Engineering Education Literature through a Values Lens

We argue that values lenses can be applied to engineering education research in ways that offer novel insights into existing findings and suggest new paths for future work. For example, research from one of the authors has explored the early work experiences of recent engineering graduates. While the initial focus was on the acclimation and on-boarding of engineers to their new work environments, reframing the findings in terms of Schwartzian values helps illuminate additional salient issues within newcomers' experiences. Specifically, Korte, Brunhaver, & Zehr [53] highlight experiences in which participants describe challenges related to a lack of control over work assignments, including how and where to complete work tasks. They quote a participant struggling with work assignments that they believe are not important enough for their given skill set. Reframed in terms of values, such challenges could reflect a potential misalignment in terms of values related to the desire for "stimulation" or meaningful "achievement." Such themes are repeated in related work from Korte et al. [54], which describe misunderstandings in the expectations of newcomer engineers and their supervisors.

Also, from Lutz's [55] research examining the school-to-work transition for recent mechanical engineering graduates, a participant describes a challenge related to his organization's tension between protecting the environment and securing profits. The participant, Doc, explains how there is a disconnect between the ethical aspect of his work and what is expected of him by his organization. The reflection below describes this conflict in more detail.

The most important thing I learned this week is that in industry (not sure how it is in academia), money moves mountains. Money can change priorities, clients and even personal relationships.

[Why?] I believe this is important because if money is the overall criteria to make a decision, ethics get forgotten. As an environmental consultant, there are many decisions that affect the environment we all live in (either good or bad). Most of our clients prefer maximum profit over the environment, which sometimes does not along with my values.

[Who helped?] My supervisor made me realize this when I turned in a project with the greenest solution but he told me the clients were not happy. So, I had to redo the work to make it more profitable.

[How did they help?] They didn't necessarily help. I understood we are also a business and it's not about going one way or the other, but about finding a balance.

[Relationship to undergrad?] Money is not something we talked a lot about in our classes. Ethics is mentioned briefly in some classes but never about the scenario I was in. In college it was always easy to find the right decision since money in the problems is fictitious. It's more complicated when you have contracts for hundreds of thousands of dollars. [Doc, Week 7]

While Lutz [55] initially frames this challenge as being related to issues of preparation for ethical decision-making and learning how to navigate various professional relationships, a Schwartzian [51] framework illuminates tensions associated with Doc's personal values of "universalism," and more specifically, protection of the environment. This scenario also presents a conflict of values related to "conformity," as demonstrated by Doc's resignation to prioritize and respect his company's values over his own.

Another theme in the current literature concerns issues of family values and potential conflict with engineering career trajectories. Winters, Matusovich, & Brunhaver [56] note the importance of family in engineers' career choices and highlight the challenges associated with starting a family on the one hand and succeeding in an engineering career on the other. These findings are echoed in more recent work by Fouad et al. [57] and Singh et al. [58], who discuss the role of work-family conflict in women's career trajectories and organizational commitment. Taken one way, such findings point to individuals' challenges to meet organizational demands and the potentially negative impact a family can have on professional advancement. However, introducing a values lens can reframe this as a misalignment between an individual's value related to "self-direction" (i.e., choice of own goals) or "family security," to name a few. Moreover, recognizing both the role of an organization in supporting an individual's personal values and the importance of alignment between personal and organizational values can help reframe the conservation to achieve mutual benefit for both parties.

Examining Contemporary Issues through a Values Lens

Situations where engineering employees are in open conflict with their employers are becoming more and more visible. Recently, many of these open conflicts seem to revolve around the role of large tech companies in society and how engineering employees are impacted by or try to direct those roles. A few recent examples are employees at Amazon, Microsoft, and IBM engineers protesting their facial recognition software being sold to law enforcement [15], and Google, Amazon, and Microsoft protesting their companies' involvement with oil and gas companies [19]. Deep dives into these and many other examples through a values lens could highlight more saliently how values play into worker satisfaction, productivity, well-being, etc. This paper demonstrates using Schwartz's framework to identify the role of values in two example cases.

Facebook and free speech: In the summer of 2020, as protests grew around the country in response to the death of George Floyd by police in Minneapolis, employees at Facebook began to speak out about how the social media platform was being used, specifically concerning messages promoting hate, violence, or the spread of misinformation. Several engineers made public resignations [13], and others staged a virtual walkout as many of them were already working remotely due to the COVID-19 pandemic [14]. This example, seen through a values lens, seems to highlight at least two value incongruencies that led engineers to quit or walk out. The concern about how the social media platform could promote hate speech is evidence of a conflict around the "universalism" and social justice. In this way, employees' commitments to equality, justice, and protection for all people came into conflict with Facebook's decision to allow specific posts suggesting violence against protesters to remain online. Second, it could be argued that values around "social security" were also in play when the employee who resigned publicly cited concerns that the hateful messages allowed to remain posted could lead to increased public violence and discord and disrupt public safety and security. These values could be held in contrast to the employee's willingness to compromise their own value of "personal

security” through the risk or reality of losing their jobs. The values lens helps us see how different values are weighted in certain decision making and when individuals are willing to jeopardize or sideline one value to highlight another.

Google and warfare technology development: Over a series of months in 2018, software engineers at Google vocalized concerns about a contract between Google and the Defense Department called Project Maven to improve machine learning for object and person identification with drones [16]. Employees at first expressed concern on internal message boards, which Google facilitates to promote such conversations. Several months later, nearly 4,000 employees signed a letter urging that Google step back from the contract and Google software should not be used in applications that could lead to harm. A dozen employees publicly resigned, and Google announced that it would not renew its contracts with the Pentagon the following month [17]. In the many articles about this topic, employees cited ethical concerns over using their technology in applications that could harm others.

Employees’ response to the use of their AI software for military applications speaks to a values conflict related to “national security” where the safety and stability of the wider global community are considered, as well as the values of “universalism.” Similar to the previous example, employees’ choices to speak out and even resign over this issue speaks, at least in part, to how they prioritize some values over others. From a broader perspective, issues like these, seen through a values lens, can also provide fruitful language for individuals, groups, and corporations to talk about challenging issues like these and identify which values are in play and how they are being considered in key decision-making.

It is worth noting that both media examples likely display similar values conflicts because these are the type and scale of conflicts that make it into the news. A broader scope of Schwartzian values (e.g., power, benevolence, tradition) probably comes into play in everyday experiences among engineers at their workplace. However, these micro-experiences do not make headlines and so would go uncaptured in an examination of contemporary issues in the media.

Lessons from Applying a Values Lens

Without a fuller appreciation and exploration of the role of value alignment in the professional formation of engineers, it seems that conversations around preparedness and skills gaps will persist and continue to perplex both academia and industry in terms of how best to serve our emerging professionals. We argue that several new and interesting aspects of professional formation exist that the use of values lenses can illuminate. We outline some of these potential benefits in this section.

First, exploring school-to-work transitions through the lens of values alignment can help better understand a broader range of challenges experienced by emerging professionals. As our section above highlights, engineers face a wide range of challenges in their workplaces that cannot always be reduced to gaps or differences in skills and knowledge (e.g., family-life balance, social support, public health, warfare technology development). Further, while gaps in skills can negatively affect an organization’s bottom line, such as in training or onboarding costs, misalignments in values between individuals and organizations can be potentially more costly (e.g., in the case of a massive strike). By exploring the role of values in engineers’ professional

development and decision-making, organizations can work with their employees to address challenges in ways that more fully enhance performance, commitment, and satisfaction and benefit both the organization and individual.

Second, thinking in terms of values can help engineering educators offer students a language to be more reflective on and aware of their own personal values. Such thinking could help them make more informed decisions about the kind of work they do and how their values might affect the career choices they make. Engineering education scholars and sociologists have drawn attention to and critiqued the perceived “value-neutrality” of engineering work, and we argue that these cultural myths also influence the way engineering students form ideas about what it means to do engineering. We refer to this as a myth because, in 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 [25] [59]. Therefore, when subjective values are seen as a hindrance to the core of engineering problem solving and work, engineering students might not be given sufficient opportunity to think about and reflect on their own personal values and how they might (mis)align with those of their organization or even the profession more broadly. We recommend that educators exemplify this process for students by discussing why they choose to teach certain material over others and even why they choose to engage in the various research and service projects they work on.

Finally, incorporating a values lens is useful because it helps frame issues of professional formation as one in which *negotiation* occurs between an individual and their organization. Most existing research on engineers’ workplace experiences has been framed in terms of gaps in skills or preparedness, emphasizing the individuals’ need to fit in or perform in ways that align with organizational expectations (i.e., organizational values). This framing positions engineers, particularly newcomers, to learn and acclimate to an organization’s norms and values to meet them and succeed within that organization. This approach, in turn, overlooks the role of the organization in supporting an individual or facilitating purposeful enculturation. By considering such issues in terms of values *alignment*, we conceptualize the interaction between an individual and their organization as one requiring both parties to work toward stasis or agreement and in which the individual’s values and priorities help shape those of the organization. To this end, this focus on values could also be a useful tool for engineering departments and organizations to reflect on the values they express and consciously examine if those values align with what they profess as their mission.

Future Directions for Research

Current engineering research has primarily focused on the role of “skills and knowledge gaps” and therefore overlooked how values play a role in the experience and formation of engineering professionals. Our position is thus that engineering education researchers should explore the new avenues that open up when applying a values lens to the study of engineers. Though there are many more, we envision and lay out three primary directions we see as particularly promising in addressing engineering education and practice issues.

First, a key moderator of value incongruence appears to be *empowerment*, or the state of having the resources, authority, opportunity, and motivation to do one’s work [60]. Empowerment can impact factors ranging from the nature of a worker’s job responsibilities to their interactions with

others and stems from perceptions of both the organization and the individual [61]. Research estimates that a failure to empower employees in their work costs U.S. businesses up to \$550 billion annually [62]. The interaction between value incongruence and empowerment is critical because it highlights a space where engineers might experience tensions that their engineering education makes them ill-equipped to address [24] [38]. Notably, Chatman [63] postulates that a person can successfully overcome potential adverse effects caused by person-organization value incongruence—and even influence the organization’s values to be more like their own—if they feel empowered (i.e., perceive themselves as having self-efficacy and control) over the situation. We argue that these tensions remain because scholars have not adequately addressed interaction between person-organizational value congruence and empowerment in engineering practice.

Second, we posit that recent graduates will feel better prepared and more satisfied in their first jobs if helped to (1) become more aware of their personal values, (2) learn more about organizational values, and (3) identify tensions between their personal and organizational values and exercise agency in navigating these tensions. For example, when emerging engineering professionals encounter areas in which their organization holds values that conflict with their personal values, how much power or control do they have in addressing that conflict? Researchers should examine the role of personal values and empowerment in engineers’ professional formation. In particular, we believe research should focus on how their values are developed, especially throughout their engineering education, and how those values are negotiated and evolve within their hiring organizations during professional formation. Furthermore, just as values can be used to explore conflicts or misalignments, they can also be a fruitful lens to explore when the alignment between values goes well. Examining situations where the values are strongly aligned between individuals and their companies may help explain why some employees are more successful and satisfied with their work. In both cases, by drawing explicit attention to the role and importance of values in engineering education and practice, we might be able to empower emerging engineering professionals to take more active roles in identifying and working to minimize (or at least address) values gaps as they engage with their new organizations.

A final avenue through which a values lens may be a powerful tool for research is in making explicit the implicit values held in various engineering environments (e.g., school and work). Exploring spaces of conflict and alignment from a values perspective creates a space in which values must be explicitly addressed. The benefit of this approach is that values influence decisions and organizational cultures, whether they are named or not. This approach would mirror and could be held in conjunction with Hidden Curriculum research already exploring implicit messaging in engineering education [64] [65] and other spaces. Exploring the values which are implicitly taught in engineering education and work could highlight critical differences that, at the very least, set up situations where students must negotiate a transition between what they experienced in school and what they experience at work from a values perspective.

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