Diversity and Inclusion in the Engineering Workplace: A Call for Majority Intentionality to Increase Career Self-Efficacy

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Abstract – Engineering has been a key component of the U.S.'s global technological superiority. U.S. racial demographics are changing, however. The number of whites currently in the workforce and the number entering the workforce will decrease over the next 30-40 years. The number of underrepresented minority engineering graduates is not on a path to meet the shortfall. Science, technology, engineering, and mathematics programs attempt to address this with attention in primary and secondary schools, and in college. Nonetheless, the underrepresented engineer enters the engineering workforce where career attainment is less likely than for the majority and where workplace environments can contain significant barriers. Career self-efficacy—a belief in one's ability to plan, implement, and execute the courses of action required to attain in one's career—may be one way to assess the gap between attainment and opportunity; intentionality may be one way to improve career self-efficacy. The purposes of this paper are twofold: (1) to encourage the expansion of the career self-efficacy concept into the engineering workplace and (2) to apply Husserl's view of intentionality to career self-efficacy and social cognitive career theory.

Keywords: career self-efficacy, intentionality, engineering workplace, diversity, inclusion

CHANGING DEMOGRAPHICS AND THE ENGINEER: GRAND CHALLENGE IN THE FUTURE

Engineering has been a key component of the U.S.'s global technological superiority [1]. Today's U.S. engineering workforce is predominately white ([2], [3]), and the U.S. engineering career field has been described as a haven of "whiteness and masculinity" ([4], p. 86) and as "pale [and] male" ([5], p. 9). Whites, along with Asians, are overrepresented in engineering when compared to their proportion of the general U.S. population ([2], [3]). Blacks and non-white Hispanics are underrepresented ([2], [3], [6]), and their progress towards proportionate representation in the engineering field has been unchanged over the last 30 years [3].

Changing Demographics

U.S. racial demographics are changing. According to a Census Bureau report [7] the U.S. will be non-majority by 2043, with a non-majority workplace by 2060. As part of this change in the U.S. racial demographic, both the number of white engineers currently in the workforce and the number of white engineers entering the workforce will also decrease at current matriculation rates. The number of underrepresented minority engineering graduates is not on pace to meet the shortfall [3]. Quoting the president of the National Council for Minorities in Engineering in a recent report, "we cannot—and should not—expect young white males to replace them" ([8], p. 4).

Engineering has been one of the least successful fields in diversifying its workforce [4], as shown in Table 1. The percentage of blacks and Hispanics in engineering is much lower than their population distribution. Blacks continue to account for only three to six percent of all engineering graduates and Hispanics account for approximately eight percent ([3], [4], [9], [10], [11]). The message from this table is that as white engineers attrite, the growing minority

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elements are not producing the number of engineers required to sustain the necessary workforce. The current solution to this shortfall is to allow more foreign born engineers to enter the U.S. ([11], [12]). Inherently, this is not

Table 1: Race as a percentage of the U.S. general population and US engineering population

Race[a]	General Population[d] (1960)	General Population[d] (2010)	Working Engineers[e] (2008)	College Enrollment[e] (2009)	College Graduation[e] (2010)	General Population[d] (2060 proj.)
White	83	64	73	67	70	43
Asian[b]	<1	5	16	11	12	8
Black	11	12	3	5	5	15
Hispanic	5	16	6	10	8	31
Other[c]	<1	3	<1	7[f]	6[f]	3

Note: [a]Categories according to the U.S. Census Bureau and the NSF. [b]Asian includes Asian and Hawaii/Pacific Islander classifications. [c]Other includes Native American and Multi-Racial. [d]U.S. Census Bureau. [e]National Science Foundation. [f]Includes foreign nationals

a negative. However, the disparity in income and wealth between underrepresented U.S. minorities and the majority could be addressed by higher incomes associated with engineering [13]. It is preferable to increase the percentage of U.S. citizens in engineering rather than filling the need by hiring non-U.S. citizens, an action that is not possible in some sectors [14].

Science, Technology, Engineering, and Mathematics (STEM) in High School and College

Attention to the recruitment and retention of underrepresented minorities in engineering is well documented in literature ([4], [9], [10], [11], [15]). Yet despite the emphasis on science and mathematics for underrepresented minority students in high school ([15], [16], [17]), and retention activities in historically black, Hispanic-serving, and predominantly white college institutions [18], the percentage of underrepresented racial minorities in engineering has remained at a consistently low level. Underrepresentation in high school and college begins to set the basis for the attainment gap and underrepresentation of the minority engineer in the engineering workplace.

ENGINEERING WORKPLACE

Attainment

Despite the attention in high school and college, the underrepresented minority engineer enters the engineering workforce where career attainment is less likely than for the white majority ([2], [3], [11], [19], [20]). Underrepresented minority engineers do not advance in their desired career paths, including management ranks, at the same rate as whites; estimates range from 40% to 13 times less likely depending on the metric ([2], [11], [19], [20]). Tang notes that while minority "engineers may have overcome barriers in the education system, results…show that they have not achieved a comparable rate of success in the occupational system" ([11], p. 201). In their desk reference on diversity, Gardenswartz and Rowe [21] note that there is an overall perception that things have gotten better—that underrepresented minorities attain at the same levels as whites—although this is not the case ([2], [3]).

In *Breaking Through*, an in-depth assessment of 20 minority individuals who had made it to the highest levels of management, Thomas and Gabarro noted that there are few minorities overall that have been able to navigate the "insurmountable" ([20], p. 5) obstacles that keep them from career attainment. Three major barriers to attainment were noted: prejudice, majority comfort and risk, and identifying high-promise minorities. The overall conclusion of this study was that minorities must get started a lot earlier in their careers to advance to the same levels as whites due to a longer "proving period" [20] and deeper review of their progress. Their data also showed that minorities making their breakaway career moves were required to change organizations, locations, and take on special projects twice as often as whites.

Environment

Underrepresented minority engineering graduates find employment in majority engineering workplaces where they are less likely to advance than their white counterparts ([11], [22]); are subject to homosocial reproduction [23]; experience structural, social, occupational segregation [19], and homophily [24]; suffer from stereotype threat [18]; and deal with spatial segregation [22], racism [19], and bias [25]. Even skin tone [26] can have a negative impact on how one is received. Table 2 presents a summary of workplace environmental conditions.

Table 2: Workplace environmental conditions

Condition	Description	Citation
Bias	"One source of gender and racial inequality in the workplace is stereotyping and bias among managers who make hiring and promotion decisions"	[27], p. 23
Homophily	"Homophily is the principle that a contact between similar people occurs at a higher rate than among dissimilar people"	[24], p. 416
Homosocial reproduction	"Managers tend to carefully guard power and privilege for those who fit in, for those they see as 'their kind'…reproducing themselves "in their own image"	[23], p. 48
Occupational segregation	The channeling of a minority into a minority job	[19], [22], [28], [29]
Social segregation	"minorities lack access to important workplace relationships that are important in developing one's career"	([19], p. 79), [30]
Spatial segregation	Resulting from occupational segregation, locating minorities in minority jobs together in the workplace	[22]
Stereotype threat	"stereotypes and negative expectations often create obstacles and difficulties for minority employees in U.S. organizations"	[18], ([31], p. 486)
Structural segregation	Minorities are overrepresented at the lower levels of the organization and underrepresented at the higher levels	[19], [30]
Subtle forms of racism	"prejudice is conveyed through white opposition to [minority] demands and resentment at their special treatment"	[19], [32]

Diversity and Inclusion Efforts

Attainment and workplace environment issues exist despite the $8 billion to $10 billion companies spend annually on diversity programs to create opportunity and inclusion strategies for minority groups [33]. Hansen's [33] analysis and summary builds heavily on Kochan, et al.'s [34] work on the business case for diversity. Hansen points out the vast amounts of diversity resources available to organizations [33]. Organizations continue to emphasize diversity, but many questions remain as to the business case.

Organizations typically enter into diversity programs for one of two reasons: legal obligation or fairness [5]. Organizational diversity efforts may manifest themselves in training programs and employee feedback [27]; as components of performance evaluations, in the form of inclusion projects, as social networking, as the responsibility of management, in the form of mentoring systems, and in affinity groups [27]. There are many case studies of successful organizational diversity initiatives and multi-organization case studies as well ([16], [27], [35], [36], [37], [38], [39]). Even with these success stories, two camps exist: one that sees value in diversity [65] and one that suggests that there is no business case for diversity [21]. For the purposes of this paper, diversity is seen as valued.

CAREER SELF-EFFICACY

The gap between opportunities generated by diversity and inclusion programs, and the attainment of the minority engineer may be assessable through the lens of career self-efficacy. Career self-efficacy is a domain-specific application of Bandura's concept of self-efficacy ([40], [41], [42]). Self-efficacy is related to social cognitive theory (SCT; [41], [42]). A subset of this theory is social cognitive career theory (SCCT; [44]) which links self-efficacy to performance and attainment.

Self-efficacy and Social Cognitive Theory

Self-efficacy—the "belief in one's capabilities to organize and execute the courses of action required to produce given attainments" ([44], p. 3)—is deeply rooted in Albert Bandura's writings on SCT ([40], [41], [43], [45]). SCT, to which self-efficacy relates [42], is used to describe the triadic relationship between the external environment,

behavior, and personal or cognitive factors ([43], [45]). A strong sense of self-efficacy is built on four principle sources: personal mastery, observation of the experiences of others, physiological state, and verbal persuasion [43].

The personal mastery experience contributes the most to one's self-efficacy ([42], [43]). An individual will judge their actions, interpret or reflect, and then alter their self-efficacy beliefs. Positive outcomes generally result in positive self-efficacy; negative outcomes tend to lower self-efficacy ([42], [43], [46]). Vicarious experience is learning through the experiences of others [43], drawing upon what they have seen others do ([43], [46]). Comparing one's abilities with others is a form of this vicarious learning experience [46]. Verbal persuasions include verbal judgments, acknowledgement, encouragement, and feedback, and are seen as weaker influences of self-efficacy than experience ([42], [46]). Physiological state—for example fatigue, stress, and anxiety—is the fourth contributing source of self-efficacy ([41], [42], [43], [46]). SCT and self-efficacy suggest that individuals have agency and control over their physiological state and this state can be altered as part of the contemplation of action, prior to action being taken ([43], [47]). Overall, self-efficacy beliefs influence how individuals behave and what actions they take [46]. The greater an individual's self-efficacy in a given behavior domain, the more likely the individual is to undertake the task rather than to avoid it.

Career self-efficacy and Social Cognitive Career Theory

Career self-efficacy is defined as the belief in one's capability to plan, implement, and execute the courses of action required to reach desired career attainments ([48], [49], [50]). Career self-efficacy ([48], [49]) research has been conducted extensively in high school and college settings, often with minority engineering students ([46], [48], [49], [51]; [52], [53], [54]).

The literature points to Hackett and Betz's [55] article on a self-efficacy approach to the career development of women as being the seminal work on career self-efficacy [41]. Their model postulated that socialization experiences caused low personal efficacy in women in relation to career-related behaviors. This then manifested itself in less than fully realized career pursuit [55]. The application of self-efficacy to career development has been seen as the most important use of Bandura's self-efficacy [56]. Taylor and Betz [57] developed the Career Decision Self-efficacy (CDSE) scale, based on Crite's career maturity theory [58]. The original 50-question scale was reduced to a 25-question short form—CDSE-SF—and validated [59].

SCCT is to SCT as career self-efficacy is to self-efficacy, a behavior domain-specific application. Lent, Brown, and Hackett [44] present a social cognitive career development framework as a specific application of SCT based in Bandura's [42] work. SCCT describes the formation of career-related interests, how career choices are made, and performance and persistence in career pursuits [44].

Five Subscales of Career Self-efficacy

The career self-efficacy subscales are based on Crites's Career Maturity Inventory (CMI, [55]). The CMI, previously known as the Vocational Development Inventory, was developed in 1961 based on Super's Career Pattern Study [60]. In its form at the time of Hackett and Betz's [58] career self-efficacy work, CMI was composed of four dimensions [61]: consistency of career choices, realism of career choice, career choice competencies, and career choice attitudes. Crites [62] hypothesized in the career choice competencies portion of the inventory, and in conjunction with the attitudes portion of the inventory, that positive career decisions are enabled by competence in five career choice processes and by a mature attitude regarding the career choice process. These five areas are self-appraisal, occupational information gathering, goal selection, problem solving, and planning.

Self-Appraisal. Crites referred to this section of his competence test, a portion of the CMI, as "knowing yourself" [63]. According to Hansen in his review of the CMI, this portion of the test was based on the assumption that individuals who can appraise the career development of others are also good self-appraisers.

Occupational Information Gathering. Crites described occupational information gathering as knowing about jobs [63]. This subscale was built on the Strong Vocational Interest and the Kuder Occupational Interest surveys [63].

Planning. Forward looking [63] is Crites's description for planning. In this portion of the CMI, Crites had respondents arrange a sequence of career-related events in the order necessary to reach a career goal.

Goal Setting. Crites described this competency as choosing a job [63]. This portion of the CMI measures one's competency for choosing occupations for hypothetical individuals with given characteristics [63].

Problem Solving. With respect to a career, what should a person do? The problem solving section of the CMI [62] addressed this question. This part of the CMI was based on the assumption that increased maturity resulted in improved decision making and problem solving related to career decision making.

INTENTIONALITY

Given that a higher career self-efficacy has been shown to increase performance ([40], [41], [42], [43]), and increased performance leads to increased attainment [44], how can the dominant majority in the engineering workplace contribute to increasing the self-efficacy and career self-efficacy of underrepresented minority engineers for the purpose of closing the gap between attainment and opportunity? One way may be to operationalize the views of *intentionality* presented by the late 19th-, early 20th-century German philosopher Edmund Husserl [64], using Husserlian views of intentionality as a theoretical structure which can guide the dominant majority in its *directedness* with respect to diversity and inclusion, both at the individual level and perhaps at the collective level.

Husserl's Intentionality

In English, intentionality can be confused with *intention* or being *intentional*. Taking this perspective, an action is intentional if it is performed with intention [66]. In Husserl's thinking and writing language, German, this was not the case. In the theory of intentionality, intention is merely another mental state such as belief, desire, or hope [68]. What is critical is the intentional mental state or the *way of being* ([66], [67]), an intentionality that exists throughout many mental states [68]. Intentionality is defined as "the property of a thought or experience that consists in its being a consciousness 'of' or 'about' something" ([66], p. xiii). Operationalized in philosophy, it means "being conscious" or "being aware" ([66], p. xiii). Husserl differentiated these mental phenomena from the more broad consciousness, where acts of intentionality are a specific subset [67]. *Directedness* is the inherent characteristic of intentionality that separates it from mere consciousness ([64], [69]).

Husserl did not see moods, emotions or other non-phenomenological acts as intentional experiences, but rather focused on acts that included a *subject*, an *object*, and an intention. The subject is the individual *intending* the object. The object is the "object of the act of consciousness" ([66], p. 5) and the intentionality is the phenomena of interest. Along with *content* and *horizon*, these elements make up the *act* of intentionality ([64], [66]). For this paper, the act is conceptualized as shown in Figure 1. The act of intentionality is perceived by the subject that is doing the intending and is experientially-based, not merely a mental exercise [69]. The best view of intentionality comes from within the experience; it is difficult to view from an external perspective without losing objectivity. Husserl also introduces *epoché*, the bracketing of the external world through the suspension of judgment. The basic principle of Husserlian intentionality is that the content of the act directs the act towards the object [64].

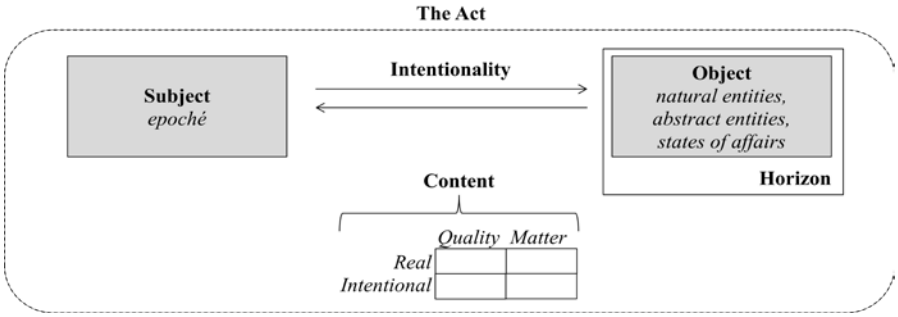

Figure 1: The act of intentionality

Subject. The subject of the act is the *ego* or person intending the object [64]. In conjunction with the intentionality, the subject is thus *intentionally related* to the object [64]. To fully intend the object, the subject must be prepared to do so [69]. The subject contributes deeply to the selection of meaning for the act [69] and is aware of possibilities created by his or her intending [66]. For the purposes of this paper, the subject is the dominant majority in the engineering workplace, the white male ([5], [11]).

Object. Husserl describes three types of objects: natural entities such as another human being or a physical object, states of affairs such as a mathematical equation or a measure, and abstract entities or "essences" [64]. These objects can be simple or complex, specific or universal, concrete or abstract, etc. As part of overall consciousness,

objects may not even be noticed by the subject; Husserl argues that these are not intentional [64]. Objects that are noticed are intentional, but may not be "intentionally related" ([66], p. 10). Objects that are intentionally related depend on a particular conception and characteristics of an object. Thus, the intentional relationship between a subject and an object is conception dependent. A concrete intentionality contains descriptive characteristics of the intended object; the object and its meaning are intentionally related [69]. For the purposes of this paper, the object of the act is improved career self-efficacy of underrepresented minority engineers.

Intentionality. Intentionality depends on how the object is conceived by the subject—conception dependence [66]. The intentionality is the intentional mental state necessary by the subject towards the object to *intend* it and is the "consciousness of something as conceived in a particular way" ([66], p. 14). Intentionality describes the characteristics of the intended object; it is what the subject is *of* or *about*. This can be directed indefinitely—lacking specific characteristics; or directly—about a specific object or entity [64]. Intentionality can be directed at the same object in several different ways ([64], [66]). For this paper, the awareness is *of* and *about* the abstract entity of career self-efficacy of the underrepresented engineer, to include the five subscales [55].

Content. An intentional act must contain intentional content. Husserl describes content as consisting of both *quality*—experience; and *matter*—or subject matter [66]. Both quality and matter can be *real* or *intentional*. The *ideal* or intentional component is the abstract structure or the meaning of the content—Husserl calls this *noema* [66]. The real component is those specific characteristics of the experience and subject matter—Husserl calls this *noesis* or meaning-giving [66]. The noematic portion of the content of the act provides its intentional relation to the object; the noesis provides the directedness [66]. Husserl suggests that the subject is not conscious of the neoma of the act without reflecting on the structure of the act.

According to Smith [64], how the content is conceived determines the outcome of the intentionality. The meaning must be identified and made visible [69]. The matter is the building block of the content, and the content is unique to the object. Matter determines the *which* and the *how* of the object intended [64]. Acts with the same matter are directed towards the same object. However, acts directed towards the same object do not have to have the same matter. Intentional content can be shared with more than one act and various subjects can have different content directed towards the same object [64]. Content is heavily shaped by the subject's biases and experiences [67].

Applied to the engineering workplace, the quality or experiential component of the content is the four sources of self-efficacy: personal mastery, vicarious learning, physiological state, and verbal persuasion. The subject matter of the content is the five subscales of career self-efficacy: self-appraisal, occupational information gathering, goal setting, planning, and problem solving. The subscales are the ideal component directed towards increasing career self-efficacy. The experiential component, or meaning giving, is provided through the sources of career self-efficacy as produced by the white male engineer towards the underrepresented minority engineer.

Horizon. Husserl describes another element of the act—the *horizon* of the experience [66]. The horizon describes the object beyond the meaning given to it by the content of the act [66]. The horizon has both an internal component and an external one [66]. Internal information is provided by the object itself [66] and can be measured through investigation or analysis. The external component is provided by the subject in relation to other objects, history, and experience [66]. According to McIntyre [66], the external horizon is constrained by beliefs and presuppositions that the subject has about the object and then brings to this experience of intentionality. These *a priori* beliefs define boundaries, reducing the meaning that can be given to a subject's perception of the act.

In this paper, it is suggested that the internal aspects of the horizon associated with the underrepresented minority engineer may be measureable through instruments such as the CDSE-SF [59]. Externally, the view of the career self-efficacy of the underrepresented minority engineer is influenced by the environmental conditions identified in Table 2, as well as the white male engineer's biases, perceptions, and personal experiences. To mitigate the effects of the external horizon, the white male engineer must invoke Husserl's concept of epoché.

Epoché. Epoché—bracketing or the suspension of judgment—allows for internal reflection and the ability of the subject to be more conscious of the intended object [64]. According to Smith [64], epoché and reflection by the subject turns inquiry away from the object and to the act of intentionality itself. This in turn allows the subject to gain access to the content of the act. Reflection uncovers the ideal quality and matter of the act, and allows the subject to reduce the difference in the noematic and noetic components by giving true meaning to the act. Applying this concept to the engineering workplace requires the white male engineer to reflect on the sources of self-efficacy and the subscales of career self-efficacy as they relate to underrepresented minority engineers, as well as examine *a*

priori beliefs which may impact this intentionality. Figure 2 depicts how these engineering-workplace specific applications of Husserl's theory of intentionality might appear.

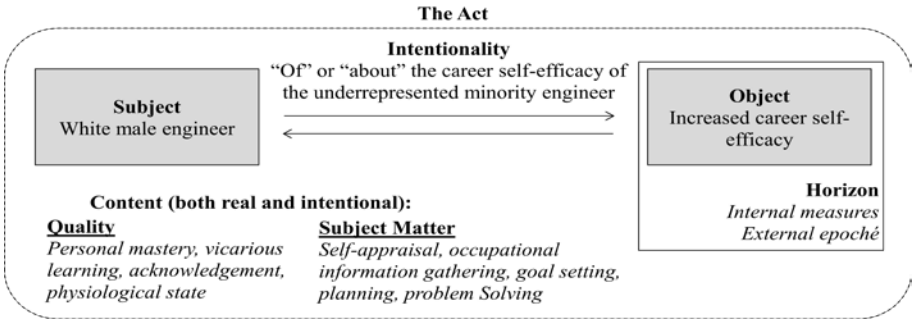

Figure 2: The act of intentionality as applied to the engineering workplace

PATH FORWARD

This paper suggests that the white male majority in the U.S. engineering workplace implement Husserl's theory of intentionality *of* and *about* the career self-efficacy of the underrepresented minority engineer. It is a forward looking way to address the impact of changing U.S. demographics on the engineering workplace. By increasing career self-efficacy, performance can increase. By increasing performance, career attainment can be achieved. Increased attainment can lead to increased satisfaction. In turn, satisfied underrepresented minority engineers encourage their children to choose engineering [77]. Implementing intentionality requires the white male engineer to invoke epoché to reduce the potential impact of the external horizon such that opportunities associated with the sources of Bandura's concept of self-efficacy in the specific career self-efficacy subscale areas identified by Hackett and Betz can be realized. In addition to implementing intentionality there may be other related areas to be considered for future research.

Use of Career Self-efficacy as a Tool for assessing the Gap between Opportunity and Attainment

Measuring career self-efficacy may be a way to assess the internal horizon associated with the underrepresented minority engineer. The literature reviewed for this paper supports the need for research in this area. Career self-efficacy has been identified as a promising construct for future research [70], specifically due to little research being conducted beyond college level subjects [74, 53]. Research into career outcomes beyond the self-efficacy intentions of students is required [17].

Underrepresentation and Career Self-efficacy

More research in the area of workplace racial relations is warranted [22]. There have been calls for studies on racism and career self-efficacy [74], diverse populations and self-efficacy [73], and on underrepresented minorities and career self-efficacy—noting that most of what we know about the CDSE-SF scale is from studies of white college students at predominately white institutions [72]. Pajares [46] called for research into multicultural perspectives in self-efficacy, as well as into prejudicially structured systems.

Collective Intentionality

Husserl's concept of intentionality is individual-subject driven. This paper's call for intentionality could be expanded to the white engineering workplace majority as a collective. Schweickard describes collective intentionality as enabling the participants to "act in that world together intentionally, in a coordinated and cooperative fashion, and to achieve collective goals" ([77], p. 1). Collective intentionality must be thought of as the awareness—the *of* or *about*—underrepresented minority engineers as a group. While there is much debate on the collectiveness of individual characteristics or the collectiveness as a group having a united essence, it is important for the majority to demonstrate collective intentionality, regardless of whether or not that is a simple summation of individual intentionalities, or something more [75]. Most important is that the white male engineer creates intentionality around increased career self-efficacy of underrepresented minority engineers, and that it becomes a shared *intending* in the workplace. True *sharedness* requires individual intentionalities aggregated into a social structure of directedness [76] towards the collective goal of an inclusive engineering workplace long before 2060.

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