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Board 232: CAREER: Disrupting the Status Quo Regarding Who Gets to Be an
Engineer—Highlights from Year 2

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Dr. Brianna Benedict McIntyre earned a Bachelor's and Master's of Science in Industrial and Systems Engineering from North Carolina A&T State University and a Doctorate of Philosophy in Engineering Education from Purdue University. She is committed to promoting inclusive excellence and serving others in her academic and local community. Among her research, service, and teaching commitments, she has also worked at the National Science Foundation to build capacity in science communication for broadening participation and citizen science efforts. Her research is grounded in understanding how interdisciplinary engineering programs exist as hybrid spaces for undergraduate students navigating a traditionally siloed engineering culture and challenging the dominant narrative of becoming an engineer. Her research efforts have resulted in publications and presentations for the science education, engineering education, and personality and social psychology research communities. In 2018, the awards committee nominated Bri and her colleagues as one of the American Society for Engineering Education's Best Diversity Paper Finalists for their paper titled Uncovering Latent Diversity: Steps Towards Understanding 'What Counts' and 'Who Belongs' in Engineering Culture. This research helped their team understand how students describe what counts in today's engineering culture and how their work can begin to encourage educators to include additional ways of knowing, thinking, and being an engineer. She is an active member and professional development leader for the American Society for Engineering Education's Commission on Diversity, Equity, and Inclusion. Her team has offered 13 interactive virtual workshops that impacted nearly 475 engineering education professionals over two years. Her most notable accomplishment was her recognition as one of seven recipients of the 2019 American Association of Colleges and Universities (AAC&U) K. Patricia Cross Future Leaders Award based on her commitment to teaching and learning and civic engagement; Purdue's College of Engineering Outstanding Service and Leadership Award in 2019; and Purdue's Graduate School Mentoring Award in 2021.

Ms. Nicole Adia Jefferson, Virginia Tech

My name is Nicole Jefferson (she/her/ma'am). I am a second-year Ph.D. student studying Engineering Education. Because of a GRA appointment where I research exemplary engineering colleges and their production of successful Black and brown engineers, I am currently interested in the preparedness of underrepresented students from undergraduate and master's engineering programs to doctoral engineering programs. I am excited about having the opportunity to become a better ENGR/ENGE researcher. In the future, I aspire to be an engineering education policy advocate and have plans to develop a research preparation consortium.

CAREER: Disrupting the Status Quo Regarding Who Gets to be an Engineer --
Highlights from Year 2

ABSTRACT

Although broadening participation efforts aim to transform who has access to engineering by targeting those historically excluded, Black and Brown students' participation remains stifled by the exclusionary culture and practices ingrained in engineering. Consequently, there is a need for scholarship that advances our understanding of systemic changes that center equity, challenge exclusionary cultural norms, and ultimately contribute to a disruption in the status quo of who gets to be an engineer. Using a multi-case research design that is framed by Kotter's *Leading Change* theory and Acker's *Inequality Regimes* as theoretical foundations, this CAREER award aims to uncover the change strategies institutionalized by five exemplary COEs to improve Black and Brown students' access to engineering education and careers. This executive summary presents insights about the second year of the study and is organized around three topics—project overview, year 2 research activity summary, and looking ahead to year 3.

MOTIVATION

Broadening participation efforts aims to transform those who can access opportunities to participate in engineering by targeting individuals historically excluded from it. However, Black and Brown students' participation in engineering at all levels remains stifled [1]–[5]; the exclusionary culture and practices ingrained in engineering is part of the reason for this persistent trend [6]–[9]. As a result, there is a growing demand for scholarship to advance our understanding of how to enact systemic change that centers equity and challenges the dominant cultural norms within engineering education. This kind of scholarship would result in generating scalable solutions that are transferable to other institutions. Consequently, this work examines the conditions and change strategies of Colleges of Engineering (COE) consistently recognized as top producers of Black and Brown engineers. Through this effort, we aim to (1) advance our understanding of the change strategies that exemplary COEs have used to improve Black and Brown students' access to engineering education and careers; (2) identify evidence-based models for broadening participation of racially and ethnically minoritized groups in engineering; and (3) set COEs on a path to parity, such that someday the student body demographics in COEs reflect the racial and ethnic composition of the nation. This NSF project started in Spring 2021; this executive summary outlines the progress of this CAREER Award to date.

Project Overview

Using a research design framed by Kotter's *Leading Change* theory and Acker's *Inequality Regimes* as theoretical foundations [10], we employed a multi-case study approach to examine how racial inequity manifests in engineering education and how each exemplar has overcome systemic issues through organizational change strategies, policies, and programming. The exemplars were selected based on two criteria—consistent recognition as a Top 20 institution by total bachelor's degrees awarded to graduates that identify as African American or *Latine*—using the American Society for Engineering Education's (ASEE) *By the Numbers Report* for 2016-2020 [1]–[5]. The modified selection of institutions recognized as exemplars in this study include: (1) Florida International University (FIU), (2) University of Maryland-College Park (UMD), (3) University of Maryland-Baltimore County (UMBC), (4) George Mason University (GMU) and (5) Morgan State University. Ultimately, this CAREER award aims to uncover the change strategies institutionalized by four exemplary COEs to improve Black and Brown students' access to engineering education and careers. The overarching question guiding this project is:

What combination of insights and actions form a robust, actionable change model for broadening participation in engineering and set COEs on a viable path to parity? The corresponding research questions include:

    1) How and why do COEs envision, implement, and institutionalize changes that address systemic inequities and positively impact the recruitment and retention of Black and Brown students?

    2) What conditions and strategies contribute to the long-term success of COEs committed to recruiting, retaining, and graduating diverse cohorts of students?

We address these research questions through multiple research and education activities. The primary research activities involve three streams of data collection for each case: 1) semi-structured interviews with at least ten participants distributed throughout and who hold unique insights about the institution's approach to addressing inequities that align with the adaptation of Acker's *Inequality Regimes* (e.g., administrators, co-curricular support staff, advisors, and faculty); 2) focus group interviews with undergraduate engineering students (e.g., at least two focus groups per exemplar comprised of students that identify as African American/Black or *Latine*/Brown); and 3) publicly available artifacts that provide further insight about the exemplar-based on insights shared by interview participants. Additional data collection efforts include campus site visits to observe the points of pride mentioned in the interviews as critical features for undergraduate engineering students' academic and social integration. These research efforts will inform the development of the three educational outcomes of the project—an impact playbook that translates research findings into practice use, exchanges with the engineering education community (e.g., dean's council, townhall discussion with associate engineering professors, and graduate engineering education webinar series), and partnerships with Virginia Tech's College of Engineering and College of Science to implement best practices

found in the playbook. A detailed description of the research design can be accessed in the previous executive summary [10].

Year 2 Research Activity Summary

Within the past year, we focused on engaging in professional development activities to build capacity in storytelling and research-practice partnerships, conducting interviews, and developing an analytic strategy that allows us to begin (re)defining the inequality regimes to improve the translation from the workplace to higher education. These efforts resulted in developing interview items to support the constructs for each inequality regime and including an additional data stream (e.g., focus group interviews with undergraduate engineering students). This section highlights the three primary activities of the project's second year.

Professional Development

The research team continues to engage in professional development activities that will build our capacity to construct compelling impact narratives that tell the story of how equity-oriented change came about at each exemplary COE. Throughout the second year, we engaged in a monthly book club to build capacity in organizational change, diversity, equity, and inclusion in engineering, and inclusive leadership. In Fall of 2022, we completed a half-day (4-hour) workshop with the South Mountain Community College (SMCC) Storytelling Institute to learn pragmatic strategies for constructing stories. In Spring 2023, we completed a graduate course on research-practice partnerships to build capacity for forming and maintaining productive partnerships in preparation for the next phase of the project focused on translating the research findings into a toolkit that can be implemented by university leaders at institutions across the United States.

Data Collection

To date, we have conducted 46 interviews with faculty, staff, and leaders across the five exemplary institutions. Originally, our recruitment strategy was focused exclusively on faculty and staff associated with admissions, financial aid, earning an undergraduate engineering degree, and/or various forms of co-curricular support. However, we have expanded the recruitment plan to target individuals who establish and maintain initiatives to diversify faculty, cultivate partnerships with community colleges, and promote curricular transformations centered on inclusive pedagogical practices. Interestingly, we have also observed emerging investments in programs and initiatives intentionally designed to support Black men in higher education in response to the decline of Black enrollment.

Table 1. The number of interviews completed to date at each exemplary institution.

	Exemplary Institution					Total
	FIU	**GMU**	**UMBC**	**UMD**	**MSU**	
# of Interviews	9	11	13	9	4	**46**

Analytic Strategy

Given the emphasis on integrating research and education activities, we developed an analytic strategy to achieve the desired research and education outcomes designed explicitly for each deliverable (e.g., journal publications, exchange insights with the engineering education community, or toolkit). To build preliminary insights and gain an overall picture of the data, we created an interview profile for each interview participant that includes principal quotes, a summary of insights within each regime, and best practices and links to programs and initiatives mentioned in the interview. This interview profile also enabled the research team to highlight gaps in our understanding of the regimes within a particular case, which informed our decisions to continue or stop our efforts to recruit participants. Then, we will use a combination of qualitative coding and data displays (e.g., case dynamics matrix) to analyze the data [11]. We will discuss additional details about the analytic strategy in the final version.

The research team has begun using this analytic strategy to begin (re)defining Acker's Inequality Regimes [12] in order to improve the translation from the workplace to higher education context. Additionally, the team has also begun to identify how the exemplars rectify inequities, within each corresponding regime that intersects across race, class, and gender.

Looking Ahead

In this executive summary, we described the progression of the project associated with the second year of the CAREER award that aims to disrupt the status quo regarding who gets to be an engineer. These data have begun to illuminate a suite of best practices for advancing diversity, equity, inclusion, and anti-racism in historically exclusionary areas of student experiences.

As we progress into the third year of the grant, we will complete our data collection and analysis efforts and begin translating the research insights into concrete deliverables and educational activities. The final data collection efforts will include focus groups with students, interviews with senior administrators, and observations of the *points of pride* during the on-site campus visits. Concurrently, we will execute multiple analytic techniques via within and cross-case analysis and document analysis to garner insights within and across each institution. Immediate next steps will involve drawing on the insights to develop the change model for broadening

engineering participation and exchanging insights with the engineering education community through a webinar series entitled *"Rectifying Inequities via Organizational Change in Engineering Education."* Additional efforts to exchange insights with the engineering education community include submitting two journal manuscripts for review focused on —1) the development of an adapted theoretical framework of Acker's Inequality Regimes to a higher education context using a grounded theory approach and 2) the development of an evidence-based change model for broadening the participation of racially and ethnically minoritized students in engineering. Collectively, these research and education activities synthesize and amplify the exemplars' efforts to disrupt the status quo of who gets to be an engineer.

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