WOMEN OF **COLOR** IN THE **ENGINEERING WORKPLACE**

EARLY CAREER ASPIRATIONS, CHALLENGES, AND SUCCESS STRATEGIES

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"I think a lot of times we cast the engineering industry as one experience, and it's obviously very compex and very diverse."

"I would say I love what I do. I love practicing engineering…. But the other things I have to deal with make me say, 'We [are] just going to keep going until we can't go anymore.'"

QUOTES FROM WOMEN ENGINEERS

"Don't get discouraged because there are people out there who aren't here for your success and your growth."

"My biggest challend in the workplace was that I didn't feel like I could be myself and work. I really felt like an outcast most of tiem time working there."

"The best advice I can give would be stand your ground, make sure you don't let anybody tell you waht you're worth."

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EXECUTIVE SUMMARY

Approximately one in four women leaves the engineering profession within the first five years, a rate much higher than their male counterparts[1]. Studies of STEM professionals have found that women encounter numerous challenges in hiring and performance reviews due to implicit bias[2]. These challenges are often multiplied for women of color, who are typically held to stricter standards of competence than whites and are less likely to be recognized for their skills[3].

This study, a joint venture between the National Society of Black Engineers and the Society of Women Engineers, was developed to gain a better understanding of the experiences of women of color in the early stages of their engineering career. Research has found that women leave the workforce at higher rates than men, and given the low representation of women of color in engineering, retention is essential to ensuring the diversity of the profession. To understand their experiences, the researchers interviewed over 30 women to examine the following questions:

1. What challenges do women of color in engineering professions face early in their career?

2. How do they overcome those challenges?

3. What types of support, particularly from professional engineering associations, are most impactful to these women?

The study explores the external support systems that assist women of color through the beginning stages of their engineering careers; of particular interest is support provided by professional engineering associations and whether or not that support is adequate. The target population for this study was women of color who were one to five years into their engineering careers. We chose this population because, while only 20% of engineering graduates are women, only one in five engineering degrees earned by women are by women of color[4].

Data were collected through one-on-one interviews of minority female engineers who graduated with a bachelor's degree between 2011 and 2015. The data collected were analyzed to identify patterns and themes around the challenges that underrepresented minority female engineers have experienced early in their careers and the strategies they have employed to cope with those challenges.

KEY FINDINGS

The researchers analyzed the data to uncover challenges, strategies, and external supports from responses obtained from female engineers of color. The following represent some of the major takeaways of this analysis.

Challenges expressed by women in this study:

- Lack of role models for minority female engineers

- Disillusionment regarding level of impact they would have as engineers

- Gender and racial biases and stereotypes experienced in the workplace

- Dissatisfaction with salary and benefits

- Unfair performance evaluations and lack of honest feedback

- Difficulty obtaining professional development through employers

Women in this study mentioned a variety of ways in which they try to address obstacles, including:

- Increasing self-confidence
- Finding their voice at work
- Developing a support system that includes family and friends, university supports, mentors, colleagues and coworkers, and professional engineering associations

Through the narratives shared by the women in this study, the researchers identified a number of recommendations to help professional engineering associations better support minority female engineers in the early stages of their career, including:

- Increase diversity in age and background within the organization, particularly among leadership
- Determine ways to maintain relevance and better support women after a job relocation
- Better accommodate women's busy schedules and dispersed locations to make it easier for women to remain active members
- Diversify events and workshop topics so women see the benefit of continuing their membership
- Help women of color find the mentors they seek as they change employers, positions, and locations

INTRODUCTION

The need to diversify the engineering profession has been emphasized for decades, with efforts in place to increase the gender and racial diversity in colleges of engineering and in the engineering workforce. Even with the increased attention and resources, women of color still comprise less than 2% of all engineering professionals[5]. Only 20% of all engineering bachelor's degree holders are women, and for women of color the statistics are even more dismal[4]. Less than 4% of engineering bachelor's degrees are awarded to African American, Hispanic, and Native American women combined, and for African American women that percentage is declining[6,4]. Researchers have identified several factors that contribute to the dearth of minorities and women in engineering, including stereotype threat, lack of role models, and feelings of isolation[7]. However, little research specifically addresses the unique challenges faced by women of color in engineering professions.

Stereotype threat may subconsciously discourage women of color from pursuing engineering careers. When a demographic with associated negative stereotypes becomes salient, individuals who fit that demographic will often experience poor performance due to the fear of confirming those stereotypes[8]. Thus, it becomes a self-fulfilling prophecy. Studies have consistently shown this effect on minorities and women as it relates to academic and engineering performance[9,10,11]. If there is only one woman of color within a workplace, she may tire of her preoccupation with defying stereotypes and choose a different career[3].

Research suggests that women of color may encounter difficulty advancing in their careers due to the lack of role models in engineering companies. Role models demonstrate that success is possible for individuals who look similar to them, and many provide direct assistance to others by serving as mentors[12,13]. Of the 682 highest-level executives at five top technology companies that employ thousands of engineers, only eight are African American or Hispanic women[14]. This is unsurprising, given the low numbers of women of color who pursue engineering, and perpetuates the image of a CEO as an old, white man. Women who do pursue engineering careers often experience difficulty advancing, meaning that the companies themselves have some responsibility for the lack of role models in upper management. Being passed over for a promotion in favor of a white and/or male candidate can certainly lead to attrition of women of color in engineering[3].

Women of color are subjected to overt discrimination in the workplace that is often more severe than what their white female counterparts experience. In a recent study of women in engineering, one African American woman shared her story of how she discovered that she was receiving a lower salary than her male coworkers with similar job titles. Furthermore, she found that a recently hired white female engineer at her company was earning more than she, even though she had a master's degree and many more years of work experience than the neophyte[15]. Another study conducted by the Society of Women Engineers revealed similar experiences of discrimination among minority female engineers[16]. These narratives are unfortunately common among women of color in engineering.

Crenshaw[17] noted the importance of examining the connections between social constructs of race, class, and gender. This intersectionality of identities should be considered when focusing on women of color in engineering. Many studies of inequality report on female engineers compared to male engineers, or black engineers compared to white engineers. Such studies assume that women of color are reflected in the experiences of the minority participants, but in many cases the experiences of women of color become difficult to parse out[18].

Though some professional engineering associations (PEAs) have shifted their rhetoric to adopt an anti-deficit framework for research focused on minority female engineers, it is still a work in progress. Organizations such as the National Society of Black Engineers (NSBE), the Society of Women Engineers (SWE), and the Society of Hispanic Professional Engineers (SHPE) provide services and support to women of color that can help them succeed in their careers[19]. However, it is still unclear whether women of color find these resources helpful and where gaps exist.

This study explores the external support systems that assist these women through the beginning stages of their careers – specifically, the supports provided by universities, colleagues, and professional associations – as well as the strategies that women of color apply to overcome early career challenges. The primary purpose of this exploratory study is to promote the narratives of early-career women of color in engineering and share their insights. We believe that by collecting and sharing the stories of women of color who have already overcome early-career challenges, researchers can highlight tangible strategies for aspiring minority female engineers to use.

METHODOLOGY

A qualitative research design was used to identify the challenges that women of color in engineering face early in their careers, as well as the strategies and supports used to overcome these challenges. The findings presented in this paper are based on data obtained from interviews of 31 eligible women of color.

To be eligible for this study, women must have graduated in or after May 2011 and have been employed in the engineering workforce for at least one year after graduation. Additionally, participants had to identify primarily as non-white. Participants were recruited through purposive sampling, using social media outlets available through NSBE and SWE. One-on-one semi-structured interviews were conducted between October 2016 and June 2017, an approach that allowed for clarification and follow-up questions. All participants signed IRB-approved consent forms and were informed of the confidentiality and anonymity of the data. Interviews ranged from 15 minutes to one hour in length.

Once the interviews were conducted, the audio files were transcribed and the data were analyzed through open and axial coding. Researchers analyzed each interview transcript by looking for categories and emerging themes. Of particular interest were themes associated with the challenges encountered, the strategies applied, and the external supports that women expressed having utilized in their job search and early career.

PARTICIPANT DEMOGRAPHICS

Thirty-three women were interviewed for this study, but two participants were ineligible because their graduation date was outside the required range. The following table lists the demographic information of the 31 women that are included in the analysis:

TABLE 1: PARTICIPANT DEMOGRAPHICS

	COUNT
RACE	
Asian/Pacific Islander	2
Black or African American	18
Hispanic or Latina	8
Native American/Alaska Native	2
Mixed Race	1
AGE (YEARS)	
<254	4
25-29	22
30+	4
No Response	1
MARITAL STATUS	
Married	7
Single	24
CHILDREN	
Yes	3
No	27
No Response	1

Most of the women interviewed were African American, while 26% were Hispanic/Latina. Women of Native American/Alaska Native origin and Asian/Pacific Islander were also represented. One woman interviewed was of mixed race. There was no eligibility criterion placed on age, but over 80% of those interviewed were under 30 years of age. Only three women interviewed stated that they had children.

PARTICIPANT DEMOGRAPHICS

As shown in Table 2, the diversity of engineering disciplines was apparent. The majority of those interviewed had earned mechanical engineering degrees, and most participants had between two to five years of work experience in engineering. Two participants indicated a little less than two years of experience, and three had over five years of experience because they included employment during college.

TABLE 2: PARTICIPANT WORK EXPERIENCE

AREA OF SPECIALIZATION	
Aerospace Engineering	3
Chemical Engineering	4
Civil Engineering	5
Computer Science	1
Electrical Engineering	3
Industrial Engineering	3
Manufacturing Engineering	1
Mechanical Engineering	9
Software Engineering	1
Systems Engineering	1
YEARS OF WORK EXPERIENCE	
< 2 years	2
2-5 years	25
5+ years	4

RESULTS

CHALLENGES

Multiple challenges surfaced among the women in this study. Women came from a variety of backgrounds and from different parts of the country but expressed similar struggles. The challenges listed below are those that were mentioned by multiple women, indicating areas of concern that should be explored to determine ways to minimize their existence and/or impact.

> "I remember when I told my dad I was doing mechanical engineering. He was like, 'Are you sure?' He's one as well…. As a black man, he's like, 'This is going to be hard. And you're also a woman. Are you sure you're ready for this?' … And now that I've been at work for a couple years, I know exactly what he meant."
>
> *– African American Engineer*

LACK OF ROLE MODELS

One potential hindrance to our ability to diversify the engineering profession is the lack of confidence and encouragement from individuals who have great influence in young girls' lives, including parents and mentors. Though most women in this study provided examples of support received from family, friends, peers, and teachers along their engineering journey, some noted having few role models to follow. For such students, external supports are critical to ensuring that they have someone who can share their experiences, explain what it is really like to be an engineer, and encourage their interest and success in the profession.

> "I'm a first-generation college kid. I emigrated here when I was 7 with my parents. My parents never went to high school…. I never had anybody to say 'you should be an engineer just like your parents are engineers'."
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> *– Latina Engineer*
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> "Make sure you have your support structures to [help you] figure out how you can get to be better than you are."
>
> *– African American Engineer*

FEELING DISILLUSIONED

Studies have found that women are particularly drawn to careers that they believe have social impact, which may help explain the higher female representation in the life sciences versus engineering and computer science[20,21]. Some women expressed disappointment that their chosen path was not offering the level of impact that they sought, and one cited her alma mater as a source of misinformation.

> "When you go to engineering schools, they kind of tell you you're going to have the opportunity to change the world and have [the] opportunity to make big changes in your team and own your own code and do a lot of stuff. And when you go to a lot of these companies, these companies are already kind of a rigid system. And you feel like a cog in this big machine."
>
> *– Asian American Engineer*
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> ───────────────
>
> "You really don't make the difference that you think you're going to make."
>
> *– African American Engineer*

RESULTS

GENDER AND RACIAL STEREOTYPES AND BIASES

Numerous participants shared their experiences of realizing that they were a minority in the engineering workplace and the difficulty of fitting in. Some expressed feelings of isolation, while others shared experiences with bias – both blatant and implicit. Studies have shown the significant impact that gender and racial biases have on women's decisions to stay or leave a profession[22]. For many engineers, relocation is a job requirement, taking women into areas of the country where people are less familiar with seeing a female engineer of color in the workplace. In some cases, this leads to more instances of isolation, overt bias, and stereotyping.

> "At work, I definitely deal with people assuming that I don't know what I'm talking about or I'm just some gentle, meek person because I'm a woman and not a man.... You lace that with the fact that I am black, and I look different than probably most of the people that are here.... The fact that I have to speak about how I'm going to do my hair so I don't get questions and so people don't ask me why is your hair so different every day.... That's something I actually think about: How do I do my hair before I go to work because of the environment I'm in."
>
> *– African American Engineer*
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> "I was the only female and the only person of color who was an engineer in our entire company.... The environment was a lot different in the South, especially in this particular plant. They weren't very accepting of having a woman of color coming in and telling them kind of what needs to be done and how things should be done."
>
> *– African American Engineer*

Interestingly, all African American women in this study referenced gendered racism, a hybrid phenomenon in which the effects of racism and sexism are experienced simultaneously[23]. Although theorizing on why this may have been the case falls outside the scope of this study, others have explored how gendered racism has particularly significant effects on African American women[24].

A number of other women in the study referenced an uncomfortable work environment primarily due to gender rather than race.

> "When I arrived here, in the breakroom on the cupboards, there was a 1950- style little thing on the wall. And it was a woman. And she said, 'I don't know what my job here is. I just drink a lot of coffee.'"
>
> *– Native American/Alaska Native Engineer*
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> "I think that there's a lot of mentality – there hasn't been a lot of women in my particular job for a couple years. There are joking comments. I think people usually apologize.... I guess I didn't expect some of those mentality jokes to still be there."
>
> *– Latina Engineer*

FEELING ISOLATED

Many women in the study mentioned that they had not really felt that they stood out as a minority female in engineering until they reached the workplace, but this was not universal. Only African American women in this study discussed isolation in college, where they had few peers who looked like them in their classes. Several African American women mentioned encountering stereotypical racist assumptions in the workplace that brought attention to the fact that they were one of very few. Latina women noted feeling isolated because they had no

one to speak Spanish with when they relocated for work. In this study, only African American and Latina women mentioned feelings of isolation in the workplace due to race and gender, while women of Native American or Asian/Pacific Islander backgrounds mentioned feelings of isolation less often.

> "When I was in Baltimore, it was all white male. And that actually was something I was very uncomfortable with because I was the only female in the room and sometimes the only person of any type of minority status."
>
> *– Latina Engineer*

> "I know I'm 1 percent of people that … look like me. I've known that through most of college. I've always counted. So sometimes when I do feel insecure, it does bring up that you're also the only person of color or female in there."
>
> *– African American Engineer*

> "… I really struggled to fit in with the team. It took … almost two and a half years [for them] to really take me seriously and start giving me assignments…. Yeah, it was just really difficult. It's not a really diverse company in any way."
>
> *– Latina Engineer*

> "… I think my biggest challenge is that I feel isolated. I came in with a cohort of other students right out of college. I didn't connect with any of them…. I don't feel connected to anyone here, not the community. It's just a whole different culture shock for me."
>
> *– African American Engineer*

NEGOTIATING SALARY AND BENEFITS

The gender pay gap that exists in the U.S. begins at the new hire stage, as many women hesitate to negotiate their salary and benefits[25]. Only 35% of the women in this study negotiated their salaries when they were first hired, and 26% negotiated their benefits package. Almost half of those interviewed indicated that they wish that they had negotiated for more when they were first offered the job.

> "When I first hired on, I received my offer… I asked if I could negotiate. They had told me that it wasn't really that flexible for negotiation…. When I got converted to full time, they said that it wasn't really a negotiable thing. I was like okay, I guess I won't negotiate my pay. So I didn't really negotiate anything."
>
> *– Latina Engineer*

> "No, I've never [negotiated]. I don't know how to do that. I'm going to go with whatever they say."
>
> *– African American Engineer*

Though some women said that they were initially satisfied with their salary offers when they took the job, a number of women stated that they learned later that they received less than others at their level.

"Looking back, I would've definitely [negotiated] because now I realize ... just from talking to other people who I work with that [coworkers who] don't have a bachelor's degree are making close to the same amount of money that I am. And I have a bachelor's degree."

– African American Engineer

"When I joined the team, I was hired in with two other new hires. And one ... had interned ... for a similar team prior to joining. And a lot of the full timers told him to negotiate the salary. And he ended up getting a signing bonus, whereas the two of us who had not interned didn't get anything additional."

– Asian American Engineer

"... I wish that I'd known starting out that everybody else got offered a lot more money than I did.... I just didn't know how much I really should have negotiated for because I didn't have anybody else to compare numbers with."

– Latina Engineer

REQUESTING DESERVED BENEFITS

Asking for benefits, including such things as professional development or a deserved promotion, can be challenging. One participant stated that her requests for such benefits were typically denied.

"When I do ask for some development ... [I'm told], 'We need to send more than one person to do that. I think it's more beneficial for two people to do that.' But we're spread so thin that we can't have time for that. And I understand that. There's really no other options for me to try to develop. It's kind of difficult."

– Latina Engineer

"Our headquarters wants you to have development....They tell you that development's very important. But they don't really develop you, so I often find that by myself."

– Latina Engineer

Some companies offer rotation programs, which a few participants indicated they were involved in and found very valuable because they had the opportunity to learn new things and try out different departments. For those women who worked for companies that offered professional development, they expressed appreciation for the value that they believed their companies had for their employees.

"I guess when I was in school, I just thought I was going to be one of those people that were going to be in one central location all of my life for the rest of my life. And this company has afforded me the opportunity to move around, try different things, rotate into different positions. And I've loved every single minute of it."

– African American Engineer

"What really surprised me is they really value their employees. They push you to continue learning, tool, and re-skill ourselves."

– Latina Engineer

Overall, the women in this study expressed a variety of challenges related to being a woman or being a minority in engineering. In some cases, it was unclear what the root causes of the issues were, as in the case of unclear performance evaluations or lack of honest feedback. The African American and Latina women in this study were more likely than Native American or Asian American women to share challenges linked to gender or racial biases.

UNFAIR PERFORMANCE EVALUATIONS AND LACK OF HONEST FEEDBACK

For many women, particularly women of color, getting honest feedback and fair performance evaluations can be a challenge. Of those interviewed, only 58% indicated feeling that their performance was evaluated fairly. Without honest feedback and guidance on how to improve, career advancement can be difficult to achieve.

Some women interviewed stated that they were receiving mixed messages in regard to their performance. In many cases, the reason for being passed over for a promotion was unclear, because they had received a positive evaluation.

> "My manager gave me the highest performance rating at the beginning of this year. I had basically asked for a promotion because I got the highest rating. I should probably get a promotion. And she said no but didn't give me any constructive feedback as to how I can get there or do anything like that. She said that I was on track from February all the way to August. And in August, she said you're not going to get it, for no reason. She said, 'Well, your attitude could be better.'"
>
> *– Asian American Engineer*

> "I feel I was treated fairly in my work evaluation. But the money did not correlate to that. So I feel I wasn't treated fairly.... If I was [rated] highly successful in what I did, then why is my raise so low? I feel on merit they were aware of how much work and how well I did my work. But they didn't acknowledge it, because the money wasn't there."
>
> *– African American Engineer*

Most women who were dissatisfied with the feedback they were receiving mentioned that they were seeking honest and constructive feedback but were getting little insight into how they could improve.

> "I've asked for the feedback. But sometimes – I guess when I ask for feedback and I set up that feedback meeting, all I've gotten is, 'Oh, you're doing great' sort of thing. And it doesn't help."
>
> *– Latina Engineer*

> "I suppose the six-month [performance evaluation] was done, but no one went over it with me."
>
> *– Native American/Alaska Native Engineer*

> "... If you're not telling me what I'm doing wrong or whatever, but you just say I'm doing fine, then it's kind of hard for me to improve on whatever I need to be doing to help you out more and be a better employee."
>
> *– African American Engineer*

SUCCESS STRATEGIES

The women in this study employed a variety of strategies to overcome the challenges they experienced in their early career. Many of the women interviewed focused on strategies that involved changes in the ways they interacted with colleagues or managers, particularly strategies that involved increasing their self-confidence, finding their voice, and gaining recognition for their work.

> "I'm comfortable at this point to contribute in certain meetings; it does not scare me. But it did take me a little bit. And I did get a little bit of pushback…. I don't care anymore. I'm going to say what I'm going to say. And you can like it or you can not."
>
> *– African American Engineer*

INCREASING SELF-CONFIDENCE

In some cases, study participants worked on specific skills to help boost their self-confidence in the workplace, including improving their public speaking. However, others felt that they had to change certain aspects of their personalities to fit in.

> "I completely changed my entire personality at work. It was horrible…. I had to learn how to interrupt people…. I had to completely stop making jokes [because] they took me seriously."
>
> *– Latina Engineer*

> "I'm trying to become a better speaker, so I'm involved in Toastmasters."
>
> *– African American Engineer*

> "…When a girl says something, I hate it that they think the girl is complaining. No, I'm not complaining. I am speaking my mind. And you should listen. It was tough. I cried the first three years working there. Then I learned to be stronger and build a thick skin…. I tell it for what it is."
>
> *– Latina Engineer*

Being afraid to ask questions was one of the most common challenges that women indicated they needed to learn to overcome. They had to learn that asking for help did not mean that they were unfit for the job. Some stated that it was a work in progress.

> "I think one of the biggest challenges I've had is kind of knowing when to ask questions. A lot of the times I feel I've asked a question maybe five or 10 times. And the person I'm asking is probably thinking I don't know what I'm doing. But I think it's more so I'm always double-checking myself…. Then there are times where I think this is the answer. But I don't want to say I think this is the answer. I want to make sure it is the answer. It's kind of like, do I really know this or do I not know this."
>
> *– Latina Engineer*

One study participant shared that she had relocated from a big city to a rural town and how she dealt with the initial feelings of isolation. She stated that she tries to understand her coworkers and, rather than change her own personality traits, become more comfortable and confident in sharing her opinions with people who think differently.

> "Everyone is literally super welcoming and very friendly. And if they say anything that has racial or sexist undertones, it's literally because they don't know any better…. They don't really understand diversity. They probably don't know that many black people. It's just a different mentality. And I just have to learn to understand where they're coming from…. I feel like I can voice my opinions. I can be myself. It wasn't always like that. I had to get over my own fears."
>
> *– African American Engineer*

FINDING THEIR VOICE

Study participants shared examples of being overlooked or ignored in the workplace. Sometimes this would occur during a meeting, while others felt that they needed to make more of an effort to develop stronger communications with their managers to ensure that their needs and ideas were being heard.

> "Things that I've been trying to do are set up one-on-ones with my team lead, not just my manager, to make sure that at least she can hear me out on a lot of things."
>
> *– Asian American Engineer*

> "One time I was working with another young engineer. Neither of us knew anything about the program, and both of us needed some extra work…. When we went into the meeting, I was never addressed, especially by name. We were sitting next to each other, and neither of us spoke. I mean, we both knew people in the room. But they would continuously address him and say he can be working on this; he can do that…. I think, looking back on it, I should've maybe spoken up a little more and been like, well, okay, he's doing that part. What should I be focusing on? And I think now that I'm slightly older – it's been over a year since that and I have started speaking up at meetings more. I make a point the first time even just making a joke – just speaking to make my presence known…. I'm easier to ignore than him, is what it felt like."
>
> *– Latina Engineer*

DEVELOPING A SUPPORT SYSTEM

The women in this study, particularly those who relocated and found themselves working in highly white, male-dominated areas, shared how they worked to find people who could help them feel less isolated.

> "I try to be friendly to everyone because you don't want to have people thinking one way typically about you because you are a woman of color…. So I try to treat everyone the same. I try to be at least cordial and happy and bubbly and make friends where I can. I try to connect with the other people of color in my organization just to build that connection, have them to lean on if I am feeling kind of weird about a situation – especially if they're higher up than me."
>
> *– African American Engineer*

> "I have a mentor in my plant. We had a plant mentor program, which I signed up for."
>
> *– African American Engineer*

Women in this study indicated a number of strategies that they utilize to help them cope with challenges they encounter in their engineering careers. Though some explained the changes that they felt they needed to make to ensure their success, including developing stronger communication skills and gaining more self-confidence in their own abilities, there were others who explained the importance of external supports in helping them achieve their career goals.

SUPPORT SYSTEMS

Study participants mentioned certain external supports that they relied upon to assist them during their job search and into the first years of their engineering career. The women in this study that were most successful in their career pursuits were those who indicated that they had a strong support system in place. Some were fortunate to have support from a variety of sources, while most indicated receiving guidance, coaching, or mentoring from one or two different sources.

> "People are very open to my questions. If I don't know how to do something, they come and help me."
>
> *– African American Engineer*

FAMILY MEMBERS AND FRIENDS

A few study participants stated that they had family members who were engineers or worked in technical fields. They sought out advice from these individuals as they made their way through their engineering degree programs and into the workforce. However, for the most part, the advice sought typically related to finding a job or dealing with career-related issues rather than addressing challenges encountered on the job.

> "My dad does consulting. He started out as an engineer. So I do talk to him quite a bit when it comes to my career-oriented things."
>
> *– Asian American Engineer*
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> "My sister is an engineer and kind of gave me some guidance. My father works with computers. His father before him worked with computers. That's kind of what geared that side."
>
> *– Latina Engineer*
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> "My father is kind of a mentor because he's also a mechanical engineer. He's been working for about 40 years in the oil industry. So I definitely leaned on him a lot....'"
>
> *– African American Engineer*

Some women mentioned the help that they received from friends, particularly when it came time to find a job. Having a strong peer network in college, especially for those women who maintained connections after graduation, was extremely beneficial to many of those in the study.

> "One of the students who had graduated from my electrical engineering program ... had posted something on a Facebook group. And he said that they were looking for engineers to submit our resumes. I submitted my resume to him. And then I got a call from [his employer]."
>
> *– Latina Engineer*
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> "I came across this particular position by reaching out to a friend at the other company I was working for, but she was leaving.... She was like, 'Keep in touch. As soon as I hear anything about an opening, I'll let you know.' And that's essentially what happened. I just kept following up with her over the next few months. And luckily an opportunity came, and I applied and was hired."
>
> *– African American Engineer*

RESULTS

UNIVERSITY SUPPORTS

When asked about the type of support received from their universities, over half of those interviewed mentioned the university career centers. They noted that the centers were a key factor in getting exposure to hiring companies and preparing for professional interviews. Many mentioned the career fairs that occurred, and though only a handful mentioned having gotten their first job through connections made at a career fair, the majority felt that the events were very helpful – particularly for those with little prior work experience. Other women mentioned the relationship with alumni in helping to prepare them for their job search.

> "My university had an amazing career center where you got resume support. And before you could post it to our online system for companies to look at, they had to approve it and review it. And you have to edit it. That was really helpful. And it also sponsored on-campus interviews. We had a great location where the companies could come. We were just on campus, so you didn't have to travel. That was really helpful. We definitely had a career fair every semester of the fall and spring."
>
> *– African American Engineer*
>
> "[Alumni members] have been very actively helping us. They look at your resume for you, [conduct] mock interviews."
>
> *– Asian American Engineer*

There were a few who indicated that academic preparation and hands-on experiences during school were factors that helped them obtain their first engineering position after graduation.

> "I [had] a lot of leadership roles back in college. And I know it's not like the exact same thing at the workplace. But it gives you almost a basic set of skills to just be able to develop into those roles."
>
> *– Latina Engineer*
>
> "So college for me, particularly the engineering school, was the first time that I had to grapple with failure. And having that kind of safe space to fail and not having too many repercussions was definitely a blessing, I would say. Engineering really taught me how to be kind of scrappy. It was an identity crisis. But I came out of it looking at myself not as a straight-A student.... I came out of it thinking I can actually be a leader."
>
> *– Asian American Engineer*

A few participants indicated that they had worked as interns or during college for certain companies. They reflected on the importance of the support that they had received from their coworkers during that period, as well as the value of having that work experience when it came time to look for a job after graduation.

MENTORS

There were some women in this study who were very proactive in seeking mentors. African American women in particular were more likely to mention the positive impact that mentoring relationships have had on their career. Few women interviewed mentioned having mentors who were women of color, though a couple of participants actively sought out women of color within their companies. However, the gender or race of the mentor was not a factor when the relationship was a positive one.

> "I've actually been pretty lucky to have good mentors throughout almost my whole career."
>
> *– Native American Engineer*

> "I think I have a lot of career guidance with my manager and some mentors I found at work. People support what I want to do and help me find the steps to do that."
>
> *– Latina Engineer*

> "I have another mentor who is also assigned to a companywide program.... And we talk all the time.... And we are as opposite as can be. She's not black – but definitely very different backgrounds and upbringings. And we talk about all things: gender, race, you name it."
>
> *– African American Engineer*

COLLEAGUES AND COWORKERS

A number of participants stated that the support they received from their colleagues helped them be more comfortable in their workplace and cope with difficult situations that sometimes arose.

> "They were always saying 'Just forget what everybody says. You're doing the right thing. Just keep on doing it.' I think there was a positive coworker relationship and getting good positive feedback from them was really helpful."
>
> *– Asian American Engineer*

> "Mostly my coworkers and peers – people that I work with who most of the time vouch for me or attest for me. They're like your sponsors. They're not your mentor but people that can advocate for you and your work."
>
> *– African American Engineer*

PROFESSIONAL ENGINEERING ASSOCIATIONS

Ninety-four percent of participants were involved with professional engineering associations during college. Many of those interviewed indicated that they valued the support offered by the organizations in college and during their job search, including networking, conferences, and scholarships.

> "I would say because I was part of SWE and went to a lot of the SWE conferences, I was better prepared for my job search."
>
> *– Asian American Engineer*

> "I was part of the Society for Hispanic Professional Engineers. My support came from them. My parents didn't go to school, so they didn't have a lot of help for me."
>
> *– Latina Engineer*

> "I like the conferences NSBE held.... They give you an introduction. They give you a one-on-one of what this company does. It did help a lot with the job search and where I saw myself working. It helped a lot."
>
> *– African American Engineer*

"[The International Society of Automation] gave me a lot of scholarships that you can't say no to when you're a poor college student. They gave me a lot of scholarships. They also had a lot of mentors that would help me with my projects. But they're family now."

– Latina Engineer

Some participants indicated that their connection to a particular PEA was primarily because they identified with other members. They sought individuals of similar race or gender in engineering.

"I'm grateful to SWE because I was able to meet other women who also had the same aspirations, especially the conference for the career fair."

– Latina Engineer

"I think my first conference was in college ... and I think it was helpful for me to kind of meet the other girls who were also studying the same thing, because [in] most of my classes, it was maybe just me and maybe one other girl – just [to] have a group of other women who are studying the same thing is good to see."

– Latina Engineer

"I could relate to people in NSBE because they were people of color. When I say people of color, I mean they came from the same culture and background as I did."

– African American Engineer

"... NSBE's just a way to see professional black people doing things so I know I stay connected and know that I was on the path that I needed to be on.... I had this group of people to go to and ask those questions because I didn't have anybody at work that I trusted enough to give me an honest answer about those things."

– African American Engineer

Only two study participants indicated that they were not currently members of at least one professional association. One was a woman who left engineering to explore her artistic interests. The other indicated dissatisfaction with the job search assistance that the PEA she belonged to in college had provided.

Generally, those who were current members of a PEA had been members of that PEA in college, with some maintaining multiple PEA memberships. There were a few women interviewed who indicated that they did not feel that they utilized their PEA's offerings to their fullest extent, particularly for mentoring or professional development.

However, for those who found themselves relocating for employment, professional associations offered networking opportunities and camaraderie that helped them feel less isolated in their new place.

"I think SHPE and SWE have the biggest influence on me – a way to network and connect with people. When I moved up here, the first thing I did was seek out my SWE section and then my SHPE section to figure out 'Where am I?'"

– Latina Engineer

> "I definitely use [the NSBE conference] as a network opportunity, and I use it for professional development.... I got a lot of great ideas and tips on how to better myself professionally. I use it in that effect, and then I use it for networking and volunteering to give back to collegiate students in my similar situation."
>
> *– African American Engineer*

> "It's nice because if I go to a new location, I'm like, 'I'm part of SWE.' 'Oh, me, too. Have you seen this? Or have you heard of a conference?' It let me reconnect with other people at my previous positions, so that was nice."
>
> *– Latina Engineer*

Support networks were an important factor in the career success of women in this study, particularly in helping them overcome certain challenges that many women encounter in the workplace. Those who indicated difficulties in either finding employment or having satisfaction in their current jobs appeared to have less access to (or less utilization of) support networks.

ADDITIONAL OBSERVATIONS

In qualitative research, observations may be presented that were not initially part of the study's research questions if there is sufficient evidence to justify their inclusion. The study revealed two observations of interest among the women interviewed. First, most of the women interviewed were either pursuing graduate degrees or were interested in going back to school to obtain an advanced degree. Second, many offered suggestions or advice for future women of color engineers to help better prepare them for their first years as employed engineers.

ASPIRATIONS

Among the 31 women interviewed, nine had master's degrees or were pursuing advanced degrees. Most advanced degree programs were in or related to engineering. Of the remaining 22 women, 16 expressed interest in returning to school at some point. Some mentioned specific degrees – master's, doctoral, MBA – whereas others did not elaborate. Many linked their potential degrees to advancement within their company or industry; however, the sources of these ideas about necessary credentials for career advancement were not clear.

> "I'm in a technical engineering position right now. And I like it. But I also want to move up in the company, possibly be a manager or a program project manager, something along those lines. And I believe that having the business knowledge of knowing how a company is run and how to run projects would be super beneficial."
>
> *– African American Engineer*

> "It wouldn't make a difference. Actually, I've done research. It wouldn't make any difference with my pay. It's just for me for knowledge and a way for me to excel in my professional career. I want to be a subject matter expert because then people listen more to you."
>
> *– Latina Engineer*

> "In addition to that, I'm definitely looking at grad school and the possibility of getting an MBA just because I don't know if staying with an engineer baseline job is going to do me any good moving forward or it's just going to be more heartache, honestly."
>
> *– Asian American Engineer*

RESULTS

Only six women indicated current interest in finding new employment – with one woman actively seeking a job because she was unemployed at the time of the interview. Only one woman in this study had left engineering and was working as a self-employed artist. Out of 31 women in this study, only one indicated any regrets in pursuing an engineering career – and it was not the artist, who stated that she still applied her engineering skills to her everyday work.

ADVICE FOR FUTURE MINORITY FEMALE ENGINEERS

During the interview, study participants often shared suggestions for future minority female engineering graduates to help them avoid some of the challenges that they had experienced in their early career. In looking back upon their own experiences, the women interviewed were able to reflect upon what worked for them, as well as what they wished they had done to better prepare themselves for the engineering workplace. While much of the advice centered on self-confidence, there were a number of women who stressed the importance of gaining work experience and networking while in college.

> "… Don't be afraid to put yourself out there. But at the same time, rejection is a natural part of the process. And don't take it too personally."
>
> *– Asian American Engineer*

> "[Do not] doubt your abilities and your knowledge…. I think the most important thing is you will have people that are going to … treat you differently, whether it's because you're young or whether it's because of something else. You can't let that interfere with what you're trying to achieve."
>
> *– Latina Engineer*

> "… Make sure you get some internship experiences and don't just focus on going to school."
>
> *– African American Engineer*

> "Make sure that you negotiate and know what you're worth and do your research."
>
> *– Native American Engineer*

> "Find the diversity societies and get active in them…. Even though I was one of two [women] in most of my classes in college, once a month there was a room of female engineers that understood exactly how much I disliked statics."
>
> *– African American Engineer*

> "Your wardrobe matters…. [When] I do my hair, [when] I wear really nice professional clothing, people listen to you more…. That's the reality."
>
> *– Latina Engineer*

> "Make sure that all your ideas are heard, and be open to criticism and feedback. Be able to step outside your comfort zone."
>
> *– African American Engineer*

The suggestions offered by the women interviewed present valuable guidance for future female engineers of color. They also provide insight into ways in which professional engineering associations can better support female minority engineers in the early years of their career.

RECOMMENDATIONS FOR PROFESSIONAL ENGINEERING ASSOCIATIONS

One of the purposes of conducting this study was to understand how PEAs can better support women in the early stages of their career. While responses to various interview questions did provide some insight, women in the study were also directly asked about the supports provided by PEAs during the job search and early career phases, and whether or not the PEA support received was or is adequate. The following recommendations are based on the feedback received.

INCREASE DIVERSITY WITHIN THE ORGANIZATION

Some of the women of Asian and Latina descent expressed concern over a lack of diversity within PEAs, particularly around age and background. Interestingly, this was not a concern voiced by African American women in this study.

> "I do think that having a diverse perspective would be really great…. I'd like to see more of an age diversity…. I don't really know how to encourage that."
>
> *– Asian American Engineer*

> "Sometimes when I listen to people talk, [they] had support already in the system…. But what happens if you didn't have that background?"
>
> *– Latina Engineer*

> "I think they could do better in diversifying [the organization's future leaders program] because those are supposed to be the future leaders of our institution, which should reflect what we want the organization to look like."
>
> *– Asian American Engineer*

Addressing why diversity was not a concern of the African American participants goes beyond the scope of this study; however, it should be noted that most African American women interviewed were NSBE members, and the vast majority of NSBE leaders are also African American.

MAINTAIN RELEVANCE AFTER JOB RELOCATION

Another concern expressed was the difficulty in finding a professional chapter to join after a job relocation, or simply difficulty obtaining guidance when approaching a job change. In some cases, location was an issue, while others mentioned the low level of activity within their local chapters. For PEAs to maintain connections with women of color after college, they must find ways to continue to be of benefit to women regardless of where they live.

> "[I dropped my PEA membership after] I visited a local chapter in my area…. They were really lowly populated, and they didn't have a lot of events. It kind of just faded out of my mind, really."
>
> *– African American Engineer*

> "Another thing is not everyone has a SWE section. The SWE Minnesota section is the entire state. And most of their events are in the Twin Cities, which is an hour and a half for me to drive. So I'm not really involved [in] what they're doing."
>
> *– Asian American Engineer*

BETTER ACCOMMODATE WORK/LIFE BALANCE

For some, juggling family, school, and work responsibilities makes it extremely difficult to stay active in PEAs. Women can take on multiple roles after college – wife, mother, graduate student – and finding time to be involved in a PEA becomes much more of a challenge. PEAs must find a way to help women stay connected during early career, even as schedules become a challenge.

> "I definitely want to get more involved with SWE. But their events are somewhere in downtown LA. And with a six-month-old, I can't really go out anywhere anymore."
>
> *– Latina Engineer*

> "I'm supposed to be a member of SWE, but I don't actually go to any meetings. I'm supposed to be member of ASCE, but I don't actually go to any meetings…. I'm trying to work and finish school at the same time and balance school life. If I were to take one off my plate and switch it for one of these professional organizations, I think they could be really very beneficial. I could see the benefits of networking."
>
> *– Native American Engineer*

> "It's just, how do you balance being a professional and being part of an organization and having a life? If you [can] juggle the 60-hour workweek with anything extra – maybe that could be addressed a little bit more."
>
> *– African American Engineer*

DIVERSIFY EVENTS AND WORKSHOP TOPICS

Some women indicated that they want to be more active, but the events that take place were not ones that attracted them to participate. Some saw PEA events as an opportunity to network, while others stated a preference for more technical or career-focused workshops, such as dealing with a hostile work environment, attention to entrepreneurial and consulting roles, understanding certifications, and salary negotiation.

> "It's a really tough sell to be like, go to another happy hour."
>
> *– Latina Engineer*

> "Maybe more ways to get more technical education or ones that fit more with where I want to go in the field… When we were trying to find things that were related for us to do, most of the times the things that we did were more social."
>
> *– African American Engineer*

> "Workshops on the section level would be great. I find that a lot of times at the meetings – and I honestly haven't been to many this year, they're not close to my area – it's a lot of talking…. I think an actual workshop would be great."
>
> *– Latina Engineer*

Many participants indicated that the job search services, particularly career fairs, were important in helping them get their first job. However, some women noted that the PEA career fairs were not as useful to women with work experience.

> "I wish I had a little more coaching on how to approach this career fair. I knew it would be a lot of college hires and interns. But I didn't know it would be pretty much all some of these companies were looking for."
>
> *– African American Engineer*

IMPROVED MENTORING

Finally, several women interviewed – particularly African American women – voiced a strong desire for mentors. Some mentioned specific characteristics that they sought in a mentor, while others stated that they needed help with knowing how to find and approach potential mentors.

> "I would like a woman technical leader to be a mentor because I've got different things I want to do. I don't know if I want to stay technical. But I want to talk to somebody who's been down the road I'm traveling.... I'm just trying to figure out where I can get that."
>
> *– African American Engineer*

> "But I think that would be before I'm looking for mentors outside of my company. That would be a great way to kind of help facilitate that. It's always awkward to see somebody and say do I just walk up to them and say, 'Hey, can you be my mentor?' It's not like a structured relationship. How does that work?"
>
> *– African American Engineer*

The women who participated in this study clearly valued their PEAs. However, they discussed several common areas for improvement, including increased diversity in leadership, better accommodation of work/life balance, and more support after a relocation. Engineering organizations may increase their relevance for early-career women of color by heeding these recommendations and providing more platforms for members to share honest feedback.

CONCLUSION

The primary purpose of this study was to promote the narratives of early-career women of color in engineering to help gain an understanding of the challenges they encounter, the strategies they use to address those challenges, and the external supports that they rely on, particularly those supports offered by professional engineering associations. Some women expressed disappointment in the low level of impact they believed they could have as an engineer, indicating that they wished that they had known this in college. Other women were unprepared for the biases they encountered in their male-dominated workplace. It was in these instances that many women indicated a need to develop their own voice and be less hesitant to express their views, so that their experience and expertise could be recognized among their colleagues and managers.

Through their own words, the experiences of early-career women of color in engineering provide a more nuanced look at the influence of race and gender in the engineering workplace. While most women in this study seemed satisfied with the supports offered during their job search, some indicated that they relied more on their own networking skills to find a job rather than the supports offered by their university or their professional associations. There were a few women who expressed difficulties in finding employment, seeming to lack access to strong supports and feeling isolated and alone in their struggles. Most women interviewed had attended job fairs, either through their university or through their professional associations, but some mentioned that PEA job fairs were less helpful now that they were experienced engineers. Those women who received multiple job offers appeared to have greater skill in developing the networks to help put them in contact with employers.

What was most lacking among the women in this study was the knowledge of how and when to negotiate their first job offers, and a number of women indicated that they felt this placed them behind many of their male colleagues in similar positions. Given the gender pay gap that exists, it is crucial that women of color are made aware of their worth and given the tools to advocate for better starting packages and career advancement. On a positive note, almost every woman interviewed expressed no regrets about her decision to pursue a career in engineering.

Regarding recommendations for PEAs to better support minority female engineers in their early career, the findings from this study indicate some room for improvement.

- Increase Diversity within the Organization: While many women belonged to at least one diversity-serving PEA, some noted that diversity in age and background – particularly in leadership positions – would be welcome.

- Maintain Relevance After Job Relocation: A number of women in the study expressed difficulties associated with maintaining membership after a job move. To ensure that members stay connected, PEA chapters may consider targeted communication toward women who have relocated.

- Better Accommodate Work/Life Balance: Many women take on multiple responsibilities after college graduation. Staying active within a PEA becomes more difficult as their responsibilities grow. Access to events that accommodate women's busy schedules and dispersed locations is critical to encouraging their continued involvement in PEAs. Additionally, normalizing dialogues around work/life balance as conference sessions or networking event topics may help more women of color feel heard and supported.

- Diversify Events and Workshop Topics: Some women shared their suggestions on possible topics and events that they felt might keep them involved in a PEA.

- Improved Mentoring Programs: Many women, particularly African American women, expressed a strong desire for a mentor, but difficulty in finding one.

It should be noted that the women in this study were primarily affiliated with SWE and NSBE, though some indicated membership with other PEAs. Therefore, any recommendations offered are not specific to one organization. Rather, the recommendations are presented broadly and should be considered by any diversity-serving PEA that desires to better support minority female engineers. By increasing the supports offered, PEAs can help reduce the attrition of women of color from the profession.

FUTURE RESEARCH

This study was prompted by the fact that there are so few women of color in engineering. We believe that providing better supports in early career can help with the retention of women of color in the profession. While the findings from this exploratory research do provide some insight into how PEAs can better support women of color in their early career, they present opportunities for further research.

We discovered that many women in this study were either pursuing graduate degrees or were interested in furthering their education. Is this prompted by job expectations, or do they see additional education as a better way to advance in their career? Do men in engineering also report desiring to pursue advanced degrees for career purposes? How critical to career advancement is an additional degree in engineering? Future studies may examine the educational attainment of upper management in engineering firms.

Another area that may warrant further research is around work/life balance. How do women of color maintain their career progression while balancing family and school responsibilities? What expectations exist that may hinder their career advancement, and how do they compare with their male counterparts?

A third area of interest is around salary and benefit negotiations. It is unclear why the women in this study were less prepared for such negotiations. Is this an issue with female engineers in general, or is this a particular issue among women of color? This seemed to be an issue across all races included in this study.

Overall, the women in this study expressed a general satisfaction with their choice to pursue engineering. The challenge we face is understanding how PEAs can help to keep them involved and engaged so they do not choose to leave the profession. As one woman who left engineering stated, "I'm happy that I got an engineering degree for a number of reasons – mostly because it opened more doors to me."

An engineering degree is valuable within and outside of the engineering field. We have to make sure that women of color in engineering see the value of staying in the profession after receiving their degrees, and understanding their needs is the only way to ensure that PEAs, universities, and employers are equipped to meet those needs.

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