Disaggregating the Monolith:
A Case Study on Varied Engineering Career Orientations and Strategies of Black Women in Tech

Janice L. Hall

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Walter C. Lee, Chair
Bevlee A. Watford
Holly M. Matusovich
Monique Ross

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ABSTRACT

Diversifying the engineering workforce has been a national imperative for several decades. The increased participation of Black students in engineering is commonly identified as a crucial area for improvement. Yet, the rates of engineering degree completion are slowing for Black women in particular. In 2015, less than one percent of all U.S. engineering bachelor's degrees were awarded to Black women. To support broadening participation efforts, I use an anti-deficit approach to examine the career orientations and mobility patterns of Black women working in computing and engineering roles in the tech industry. By characterizing the different career motivations, strategies, and points of transition in the careers of a diverse sample of Black women, I sought to disaggregate the Black women's engineering and computing career experiences—particularly as it relates to how and why they move into, around and out of roles in the tech industry. Using a qualitative multi-case study, I conducted a multi-level career mobility analysis on secondary data and user-generated social media artifacts to extend theory on career orientations and talent management to help normalize "non-traditional" career trajectories. The study findings are useful to inform the next generation of Black women interested in tech on the different ways to approach and achieve subjective career success and satisfaction in engineering and computing fields. In this dissertation work, I discuss how the varied insights of Black women's career experiences in tech can be leveraged for practitioners and industry leaders to broaden the participation (e.g., to attract, retain and better support) of students and employees by identifying their career orientations and then using that to inform career preparation and development that aligns with different engineering and computing career outlooks.

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GENERAL AUDIENCE ABSTRACT

The lack of role models is a hindrance for aspiring Black women engineers and their decisions to continue choosing engineering. The lack of representation of Black women in industry similarly presents obstacles for their career advancement. Because neither role models or representation can be increased in retrospect, it is imperative to study and highlight the visibility of the Black women engineers currently practicing engineering and bring awareness to their career experiences in industry to better inform recruitment and retention efforts.

The purpose of this qualitative multi-case study is to describe the varied career orientations of Black women working as engineers in Tech and to link their career orientations to their career outcomes. To support broadening participation efforts, this research uses an anti-deficit approach to examine the career mobility patterns of Black women working in computing and engineering roles in the Tech industry. Using a curated secondary data set based on social media artifacts and user generated data, this study characterizes the different career motivations, strategies, and points of transition in the careers of a diverse sample of Black women. In efforts to disaggregate Black women's engineering and computing career experiences, ten perspectives on how and why Black women move into, around and out of roles in the tech industry were examined. The analysis revealed that participants' career orientations were differentially motivated by needs, talents and or values which influenced how participants made career related decisions. Additionally, both physical and psychological mobility of participants was examined and then compared in the cross-case analysis to derive six unique career archetypes that were useful in characterizing the career challenges and aspirations in participants' lived career experience.

This study aims to normalize "non-traditional" career trajectories and inform the next generation of Black women interested in Tech on the different way(s) to approach and achieve career success and satisfaction in engineering and computing fields. In addition, study findings can be leveraged by human resource personnel and career managers to anticipate common career challenges based on individual employee career orientations, and align better reward structures and policies to support a wider range of employee career outlooks. The study emphasizes the strategies and outlooks critical for Black women's success and satisfaction to support their continued participation in the engineering and computing workforce.

DEDICATION

As a first-generation college student, I dedicate this dissertation to my family. To my siblings and host of aunts, uncles and cousins thank you for all your encouraging words throughout this educational journey, I can never quite capture how grateful I am. To my late grandparents: Andrew and Lucinda Cunningham and Rudolf and Herta Veit my only regret is that I did not finish sooner. I know you all are proud of me all the same. To my parents, Alexander, and Monika Cunningham, thank you for always believing in me and instilling in me a love for education. You both taught me how to work hard and be disciplined and look where it has gotten me.

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Chapter 1: Introduction

Broadening the participation of historically underrepresented groups (e.g., women) in science, technology, engineering, and mathematics (STEM) has proven to be a persistence challenge, despite monetary and educational investments. In the last decade alone (2010-2019), the federal government invested around $3 billion annually on STEM education (Granovskiy, 2018). These funds have gone to both practical endeavors, such as education outreach, as well as research. However, even after increased awareness and decades of studies identifying barriers that hinder access and prevent equitable participation, women continue to encounter numerous challenges when entering the STEM workforce (Corbett & Hill, 2015; Hill, Corbett, & St Rose, 2010; Rincon & Yates, 2018). In engineering, for example, women account for only ~20% of all bachelor's degree holders (Yoder, 2017), with one in four of these women subsequently leaving the engineering profession within the first five years (Rincon & Yates, 2018). For women of color (WOC) the statistics are even more dismal, where African American, Hispanic, and Native American women hold less than 4% of engineering bachelor's degrees combined and make up less than 2% of the engineering workforce (Falkenheim, Burke, Muhlberger, & Hale, 2017; Rincon & Yates, 2018; Yoder, 2017). Diversity metrics seem to have reached a plateau for women of color (WOC), and for African American women—the focus of this dissertation—that percentage is declining (Falkenheim, et.al., 2017; Rincon & Yates, 2018).

Though it may be comforting for some to believe so, the lack of Black women is not because of their disinterest in STEM. Data support that WOC are just as likely as their counterparts to have an interest in and pursue STEM degrees and careers (Dorsen, Carlson, & Goodyear, 2006; Ong, Wright, Espinosa, & Orfield, 2011). Since the 1970s, WOC have received more STEM degrees proportional to their national representation than their counterparts (i.e., White women and men of any color) (Burrelli, 2009; Ong et al., 2011). However, these gains have not translated into a more diverse STEM workforce. Despite their degree attainment, Black women, and other underrepresented groups of women in engineering have continuously had a diminished presence in the workforce (Ong et al., 2011; Wang, Eccles, & Kenny, 2013).

Researchers have identified that implicit biases in STEM hiring practices make it harder for women in general to enter (Hill et al., 2010). For Black women who do successfully transition from STEM education into the engineering workforce, there are additional challenges. Once employed, Black women appear to get "stuck" in junior-level positions, failing to advance to positions of leadership (Ong et al., 2011). The implicit bias that occurs in hiring continues in the job performance reviews for employees from underrepresented groups (Hill et al., 2010). Implicit bias directly impacts engineering career development and potential for promotion (Hedge, Borman, & Bourne, 2006) for underrepresented

WOC collectively as they are held to stricter standards of competence than their White counterparts in evaluation of their job performance (Rincon & Yates, 2018). These factors simultaneously contribute to the low percentage of underrepresented WOC in the engineering workforce and the slow decline of the already poorly represented Black women from the engineering profession.

Collectively, the aforementioned factors describe the compounded systems of oppression and challenges faced by Black women when trying to participate in the engineering profession. The evidence of these factors and the connections they weave across events—biases in hiring and biases impacting promotion opportunities—have resulted in a narrative centering on discrimination as the base for what is contributing to the reduced quantity of Black women participating in the engineering workforce. Although real, this narrative is over simplified, lacking appreciation and understanding for the agency Black women possess in dictating how they participate, where they participate, and what their participation entails. Recent qualitative insights have specifically linked representation, or lack thereof, directly to challenges of broadening participation of Black women in engineering (Morton & Parsons, 2018; M. Ross, Capobianco, & Godwin, 2017).

Additionally, the business case for diversity, or the hyper focus on increasing the quantity of Black women qualified to contribute to the engineering workforce, leaves little to no consideration for the quality of the experiences or satisfaction that Black women have in an engineering career. Black women who leave—whether an organization or the profession broadly—are largely painted as having a deficit-role (e.g., not resilient enough, not talented enough) when it comes to their career. Herein, I argue that Black women's experiences in engineering careers are not monolithic. Sure, there are common themes among their shared experiences, but some Black women exercise career mobility strategies to circumvent or outright avoid hiring and promotion bias in a work environment to much success (Ebrahim & Singh, 2017); and there may be others that navigate a career path looking for alignment with self-concept, (Super, 1980) a career where the personal and professional boundary is less rigid (M. Ross et al., 2017).

In trying to broaden the participation of Black women in the engineering profession, we must understand the various ways Black women have careers as engineers. We need insight on individual job choices, professional development strategies, and knowledge of the underlying values associated with actions to illuminate patterns associated with Black women's meaning of career. Accordingly, my dissertation contributes to a larger discussion on missing information regarding how Black women make meaning of their careers. I examined the individual and holistic experiences of Black women engineers in the workforce and their decisions related to working in engineering and computing roles in the tech industry. I use the next section to highlight the literature gaps hampering efforts to broaden the participation of Black women in engineering.

1.1 Hinderances to Broadening Participation & Advancement: Knowledge Gaps on Black women

The literature on workplace studies and gender equality reveals a history of problematic aspects of engineering and STEM work environments and cultures contributing to the departure of women and people from other marginalized groups. However, despite over 40 years of trying to diversify the STEM workforce, efforts to attract and retain Black women in engineering have yet to yield much progress. In fact, M. Ross and Godwin (2015) found that Black women accounted for 0.43% of engineering workforce, a number that often renders this group insignificant for large quantitative studies. It has been argued by Ong et.al. (2011) that the efforts of researchers, educators, and policymakers to effect change at broadening participation and advancement of underrepresented WOC specifically could be aided if knowledge were extended in three critical ways: (1) more studies sensitive to the effects of combined oppression of race, gender, and class; (2) more studies disaggregating workplace experiences of minorities and across STEM and non-STEM fields; and (3) more studies analyzing personal and shared experiences of individuals and their environment. I add a fourth suggestion: more studies on normalizing 'other' ways of participating in engineering. This means acknowledge different ways of enacting engineering careers.

First, informing efforts to diversify STEM is a challenge because most of our knowledge is aggregated across experiences of historically marginalized groups, including broad categorizations of women and people of color (POC) (Ong et al, 2011). There are few studies in the literature that focus on the experiences of WOC in STEM, and many of them treat WOC as a monolithic unit (Ong et.al., 2011). This clustering is problematic because it obscures the challenges faced by sub-groups: not every minority group has similar experiences. Moreover, the challenges faced by WOC are more than the sum of issues experienced by White women and men of color (Li, 2014).

Second, the interchangeable and aggregate use of STEM or Science and Engineering (S&E) to describe multiple industries can undermine the severity of underrepresentation of a single group (C. J. Brooks, 2012; Bynum & Stordy, 2017). For instance, women have either reached or surpassed gender parity in fields like healthcare, where they account for (75%) of practitioners and technicians (Funk & Parker, 2018). Similarly, in 2012, Asian employees made up 50.1% of technology workers in Silicon Valley, though their proportion in the U.S. population was only 5.6% (Nakaso, 2012). Further disaggregating by race/ethnicity and gender and looking at STEM fields individually reveals disproportionate representation of diversity among sub-groups (Li, 2014).

The third gap in the literature is a need for more targeted studies spanning life stages (e.g., graduate school, early career) focused on WOC as individuals and their shared experiences in STEM

workplaces (Ong et al., 2011). A bulk of the literature on broadening participation in STEM focuses on a system-level view (i.e., policies and practices) with an emphasis on early access (K-12) and post-secondary education (Lee, 2019). Fortunately, there has been growing attention around intersectional and qualitative studies that examine the experiences of Black women engineers in industry (Fletcher et al.; Fouad, Singh, Fitzpatrick, & Liu, 2011; Funk & Parker, 2018; Rincon & Yates, 2018; M. Ross et al., 2017; M. Ross & Godwin, 2015; M. S. Ross, 2016; Singh et al., 2013; Slaughter, Tao, & Pearson, 2015). More engineering and STEM career studies on intersections between life domains can provide insights into career advancement. For example, "winning" qualities of successful White male CEOs suggests that certain family and community resources carried over into professional work were significant attributes to leadership skills (Ruderman, Ohlott, Panzer, & King, 2002). Because life domains, such as family and community, differ across cultures—particularly presumptions and perceptions on gender roles— more studies like Ruderman et al. (2002) are necessary for Black women and other underrepresented groups in engineering to illuminate the resources (e.g., forms of capital) they have, could utilize, or need access to in order to develop professionally (Lazarova & Taylor, 2009; McArdle, Waters, Briscoe, & Hall, 2007; Sandoval-Lucero, Maes, & Klingsmith, 2014; Yosso*, 2005).

The final critique is that broadening participation of Black women in the engineering workforce could be aided by better understanding what engineering career satisfaction look like for Black women. For example, we should look to career research and studies on career development to rethink how we characterize recent trends (e.g., slow decline) of Black women's participation in the engineering workforce. Career data indicate that Black women in engineering have a tendency for lateral engineering career moves (e.g., more temporary, or shorter durations at an organization) to presumably mitigate bias in promotion and advancement opportunities (Rincon & Yates, 2018). Attempts to avoid and circumvent bias in the workplace related to career development opportunities and advancement seems like a plausible contributor to the career patterns of Black women engineers. However, some careerists would argue that frequent lateral career moves are also characteristic and normal for individuals who hold divergent meanings associated with careers and are used to access career opportunities that suit personal values (Driver, 1982). Orienting career decisions around personal values is just one way to think about a career, and I discuss other career orientations in section 1.4 as I reframe broadening participation for Black women engineers as a career studies problem. Though the literature shows that Black women engineers are highly skilled and qualified micro-unit of workers, they are not a monolithic group, with uniform experiences of discrimination in the workplace, shared career meanings, and career aspirations. This realization requires us to acknowledge that while some Black women engineers leave organizations after short duration due to discrimination and or a lack of opportunities for advancement, others may be

equally motivated by variety and challenges of skill development, sometimes in completely new fields (Driver, 1982).

By taking stock of the evidence we have, with an awareness of what information is missing, we have a blueprint for the types of holistic studies needed to bridge the gap. In short, there are a lack of studies attentive to the multiple forms of oppression, specific contexts of work, and the multiple sources of influence across life domains and subjective meaning of career that impact the professional lives of Black women in engineering. To bridge the gap, we need more studies focused on who Black women are as individuals, the experiences they share regarding their personhood, and how that influences their enactment and views of engineering work in a STEM context (Grzywacz & Butler, 2005; Ong et al., 2011). Without research to develop an understanding at the group and individual level, we will continue to incorrectly assume and compare the career values, goals, and outcomes of Black women in STEM to that of majority groups (e.g., White men). This assumption is dangerous because it perpetuates the idea that to be successful in STEM environments, Black women must act and aspire to be like White men.

1.2 Glossary of Terms

Before proceeding further, I present a glossary of terms to help orient the reader:

- **Women of Color (WOC) –** This term refers to non-White women in STEM
- **Underrepresented Women of Color** – This term refers to all non-White and non-Asian women in STEM with a focus on Black, Latinx, and Native American women.
- **Minorities** – This term is used to refer to historically marginalized racial and ethnic groups in STEM, including women of all races and ethnicities and all non-White men.
- **Black women** – This term is used to "comprise the underlying unity of the black people whom colonization and slavery distributed across the African diaspora (p.3), with an emphasis on the subset with American citizenship (e.g., encompassing African American Women). (S. Hall, 2014)
- **Intersectionality** – The term is used to describe the structural inequalities resulting from the compounding relationship among gender, race, and class to shape multiple aspects of oppression in employment experiences for WOC (Crenshaw, 1989, 1990; Jordan-Zachery, 2007).
- **Tech workforce** – This term is used to embody work focused on the advancement, security and operation of technology involving the human created and controlled experience (Dugger Jr, 1993). It encompasses workers using trial and error or skilled approached derived from the concrete (e.g., work dependent on engineering, mathematics and science) concerning the generation of solutions to problems and the knowledge required of those solutions (Dugger Jr, 1993).

- **Career** – This term refers to the culmination of a person's life work and may be different (e.g., broader) than individual job titles and positions held (Driver, 1985).
- **Career Concept** – This term, synonymous for career orientation, career anchors or career outlook, is defined as enduring, inner value(s), personal vision, and or motivation(s) dictating job related decisions (Driver, 1982).

Though my study is focused on furthering the understanding of experiences had by a particular sub-group of underrepresented WOC (i.e., Black women in the engineering workforce) in a specific STEM context (i.e., in the technology industry), due to literature gaps on WOC in STEM, the literature overview and much of the evidence for my arguments will be discussed using a variety of terms for broadening participation of minorities and women. I use the same terminology as the sources cited when discussing broadening participation in STEM to preserve the integrity of the articles, emphasizing engineering, and highlighting the few studies that specify experiences of Blacks where possible.

1.3 Multiple Approaches to Broadening Participation of Minorities and Women in STEM

In the literature, broadening participation (BP) is characterized in several ways (i.e., pipeline, pathways, ecosystems) (Clark Blickenstaff*, 2005; Lee, 2019). Not mutually exclusive, each view of BP highlights different issues and focuses on different areas. In this section, I provide brief examples of some of the systemic, environmental, and individual factors that make it particularly difficult for minorities and women in STEM to participate and advance in their careers at the rate expected given their degree attainment (Garrett, 2017). Though each perspective to BP offers insights that can aid in our understanding of how WOC experience STEM work, each offers only a partial glimpse into their workplace realities, with much of the emphasis on the challenges and factors pushing them away or out of STEM and less attention to potential opportunities motivating their movement around and out of STEM. Thus, I end this section with an argument for a need of more holistic studies on the workplace and career experiences of WOC to better understand and hopefully address their unique, non-traditional, and sometimes complex needs to participate more fully in the STEM workforce.

1.3.1 Broadening Participation: Leaky Pipeline

The bulk of the literature views the challenge of BP in STEM through a pipeline metaphor, and this is especially true for the field of engineering (Clark Blickenstaff*, 2005; Lee, 2019). The pipeline view makes inquiries at the system level with areas of focus hinging on access to formal education and training, barriers, and retention into and through STEM education and the workforce. When viewing the participation of persons through a pipeline metaphor, the measure of progress follows a more traditional,

orderly career progression (Bynum & Stordy, 2017; Lee, 2019). The pipeline metaphor positions participants as passive, putting emphasis on the system. The oft-cited solutions to fix the pipeline center on generating a critical mass, primarily through added funding to foster interest and access at each segment (e.g., K-12, secondary school, post-secondary education) (Lee, 2019), the logic being that the more diverse persons exposed to STEM in K-12 will pursue post-secondary STEM programs and will essentially increase the sheer number of diverse persons in the STEM workforce (Clark Blickenstaff*, 2005).

However, graduating more diverse persons is not enough to ensure a more diverse workforce. In addition to garnering interest in STEM education, a multitude of evidence suggests that a secondary issue, especially for WOC who graduate with STEM degrees, is retention in the engineering or broader STEM workforce (Clark Blickenstaff*, 2005). Research shows that, for decades, WOC have encountered both gender and racial bias regarding hiring, promotion, and pay, which presents barriers to their participation, persistence and career advancement (Burrelli, 2009; Bynum & Stordy, 2017; Combs, 2003; Corbett & Hill, 2015; Crawford, 2015; Ginther & Kahn, 2012; Hill et al., 2010; Jackson, Hillard, & Schneider, 2014; Mays, Coleman, & Jackson, 1996; Obiomon, Tickles, Wowo, & Holland-Hunt, 2007; Ong et al., 2011). From an industry perspective, retention of employees and organizational loyalty are ideal, but there is sufficient evidence to suggest that some individuals define careers and make decisions stemming from enduring personal values that are ill-fit with such organizational career definitions (Brousseau, Driver, Eneroth, & Larson, 1996; Driver, 1982, 1985; Driver, Coffey, & Bowen, 1987; Larsson & Driver, 1993). For example, some individuals use their careers an extension of the self (Hill et al., 2010; Super, 1980) and, therefore, their career definition and patterns resemble sporadic movement, largely driven by their motivation for identity search or personal growth (Driver, 1985; Prince, 1979).

1.3.2 Broadening Participation: Ecosystem View

The ecosystem view on BP makes inquiries on the workplace or learning environment more central and focuses on issues pertaining to relationships, connections, and culture (Lee, 2019). Key ecosystem factors impacting women and minorities in STEM are strong relationships, expansive social networks, and supportive workplace environments (Combs, 2003; Crawford, 2015; Ginther & Kahn, 2012). In the engineering wokforce, minorities encounter implicit and explicit bias that manifests as a non-inclusive work environments and chilly climate, ineffective support programs, as well as individual barriers originating from employees themselves (J. D. James, 2015). Structural barriers, like non-sensitive organizational cultural practices (e.g., after-hours networking events and meetings) and reliance on friendships, are challenges to workplace integration and promotion opportunities (Bynum & Stordy, 2017; Combs, 2003; Grzywacz & Butler, 2005; J. D. James, 2015; Kaufman, 1974; Li, 2014; M. S. Ross,

2016). Such barriers hinder the establishment of formal and informal social networks, which are a key factor hindering Black women's advancement to upper-management positions in the workplace (Combs, 2003). Improving workplace culture by eliminating the chilly climate may improve the establishment of formal social networks in the workplace, an important component for Black women who have interest in advancement, or those driven by job security (Brousseau et al., 1996; Cook & Waters, 1998; Driver, 1982, 1985).

It is unlikely that improved social networks would affect Black women with alternate career orientations in the same way (Driver, 1982). For example, a Black woman engineer with a career orientation that valued inner complexity and reliance on creativity over advancement would benefit more from temporary roles and lateral rotations in the career process (Driver, 1982). Once her need for inner development is met, this individual is likely to either withdraw or seek a new direction of growth, choosing to build on existing strengths for depth of skill development or alternating completely for breadth (Driver, 1982). An understanding of people as individuals and the nuances related to their full participation in the workforce (i.e., what drives their career decisions) will better illuminate factors of influence to garner their persistence and grow diversity in the engineering workforce. (Cook & Waters, 1998; Evetts, 1994, 2000; Herman & Lewis, 2012).

1.3.3 Broadening Participation: Pathways View

The pathways metaphor makes inquiries about BP at the level of the individual, with a focus on participation and nontraditional routes. This view situates participants as active agents and measures progress in terms of persistence, often using theories focused on identity and career choices (Burlew & Johnson, 1992; Lee, 2019; Vogt, 2008; Wang et al., 2013). Some factors that have been known to impact women and minorities from this perspective include self-directed learning, spirituality, and societal impact (Bynum & Stordy, 2017; Crawford, 2015; Ginther & Kahn, 2012). Researchers interested in pathways have identified gaps in support for individuals during transitions. For WOC, the access to role models and mentoring relationships are supposed to increase persistence during transitions to the workforce and from early career to positions of leadership (Ong et al., 2011). Yet, the relocation that is often required with engineering jobs places WOC in communities that differ from the communities with which they previously had ties. Community engagement is known to impact the establishment of informal social networks (Combs, 2003; Grzywacz & Butler, 2005; Voydanoff, 2001). Benefits of informal social networks include mentorship, advice, strategic information, social support, and buy-in, which are important merits for employment and career advancement, and unfortunately lacking for women and minorities (Combs, 2003).

While influential mentors within an organization may contribute to the persistence of some women, particularly those with leadership ambitions, I reiterate my earlier point: one size does not fit all. For others it is the interest in the technical aspects of the job or the positive work environment, or some combination of these. There is evidence that many engineers do not really desire to go into management, and rather desire to become highly competent in their line of engineering work (Driver, 1982; Larsson & Driver, 1993; Yeh, 2008). For some engineers, upward movement can be the result of social pressure or restricted reward systems for staying put (Driver, 1982; Yeh, 2008). Current research on STEM careers of WOC often identifies challenges to upward career advancement and cites low numbers of WOC in positions of leadership as evidence without acknowledging alternative career orientations (e.g., desire for impact on society over achievement reward structures common with leadership).

I introduce and discuss entrepreneurship at some length in this study because it provides new avenues and pathways to innovate what participation in the engineering profession or enactment of engineering careers looks like. Entrepreneurship also has immediate potential to disrupt career power dynamics and catapult an individuals' career advancement by placing a former lower-level employee at top of an organization's decision-making capacity (Ebrahim & Singh, 2017). For example, circumventing traditional organizational hierarchical structures like reliance on promotions from supervisors to becoming CEO of your own company overnight. Entrepreneurship also enables individuals to tailor organizational missions and visions to match their personal values and or motivations for better career fit and alignment. Organizational fit promotes persistence and overall career satisfaction for women within engineering and technology (Rincon & Yates, 2018). Given these considerations it is important to include tech entrepreneurship as career pathways for Black women if we wish to understand the broader ways individuals view their participation in the engineering profession. Career literature supports that, although less popular, non-traditional career orientations like entrepreneurship, are indeed valid and hold true for individuals across cultures, gender, race, generations, and occupations (Arnold, 2011; Baruch, Szűcs, & Gunz, 2015; Brousseau, 1990; Brousseau et al., 1996; Buzzanell & Goldzwig, 1991; Dorsen et al., 2006; Driver, 1982, 1985; Evetts, 1994, 2000; Flaherty & Pappas, 2002; Frehill, 2012; Hackett & Betz, 1981; Herman & Lewis, 2012; Lazarova & Taylor, 2009; Nauta, Epperson, & Kahn, 1998; Olson, 1980; Rincon & Yates, 2018; Super, 1980; Wang et al., 2013; Yeh, 2008).

Taken together, the pipeline, ecosystem, and pathways views provide evidence that we need a multi-faceted approach to improve BP of Black women in the engineering workforce. If we pay attention to the factors and areas of focus in each of the three views simultaneously and are inclusive of alternative and non-traditional definitions of the meaning associated with career, then holistic and perhaps more notable changes would occur in BP of WOC in engineering. My dissertation aims to do so.

1.4 Theoretical Reframing of the Problem: Purpose Statement and Research Questions

The purpose of my dissertation is to describe the varied career orientations of Black women working as engineers in Tech and to link their career orientations to their career outcomes. Although linear (i.e., upward movement) is by far the most popular and generic vision of career success (Driver 1982; Driver, 1985), there exist other globally established career orientations, as not everyone personally desires "to make it to the top". It is important to comprehend the orientation that a person has toward their career as it provides insights into career decision-making and behavior—setting career goals and subsequent actions toward those goals.

I have decided to use this dissertation to explore how the different concepts of a career impact the career mobility strategies of Black women. I used Driver's (1982) career concepts framework (CCF) to guide the assembly and analysis of this study. The CCF was developed by Driver (1985) to examine the 3-way fit between individuals, organizations, and societal workforce trends. Given that the private sector spends around 8 billion annually on diversity and inclusion efforts (Ross & Godwin, 2015), one could argue that the goals of organizations are clear regarding diversity, workforce trends highlight the dismal rates of participation among Black women in engineering, and the only unknown is what Black women think regarding their careers as engineers. The CCF is therefore useful to guide this study as it situates individual career meaning alongside broader context of organizations and society. Additionally, while most career theories focus on the internal psychological content guiding an individual's career choices (e.g., motives, values, and interests), Driver's (1985) framework combines the psychological dimensions with structural dimensions (i.e., duration, frequency, and direction of career field movements). This combination results in a distinct set of patterns that correspond to variations in the meaning people associate with a career (Brousseau, 1990; Driver, 1982, 1985; Olson, 1980).

Through empirical testing, the CCF offered widely held and subjectively valid views of the meaning of career for a large international sample of workers (Driver, 1985). The CCF is useful to guide this study because it includes career concepts that describe the current trends of Black women engineers in the tech industry (e.g., frequent lateral job changes and short duration within a given company), while considering organizational and societal factors. Upon testing the CCF, Driver (1985) found four main career concepts that account for the bulk of the thematic differences characterizing individuals' meaning and enactment of career (Brousseau, 1990; Driver, 1982, 1985; Olson, 1980; Prince, 1979) . See Table 1, for an overview of each of the definitions and characteristic patterns for the four career concepts in Driver's (1985) framework. Through his work, it also became evident that career patterns for women and minorities tend to be less linear than that of White men (Driver, 1985).

Table 1. Career Concepts Definitions and Patterns adapted from Driver (1985)

				
Concept Label	Linear	Steady-State	Transitory	Spiral
Definition	Career success hinges on continued upward movement, endemic to fields like management and politics. Most familiar concept and pervasive within our culture, may be present in professional fields	Defines career as a vocation or calling. Demonstrated by a lifelong commitment to a field. Prominent examples include professions like medicine or engineering and carpentry	Defined as a consistent pattern of inconsistency that generates a random walk from outsider perspective. Characterized by nearly constant and apparently erratic movements	Defined as individuals who consciously or otherwise make a major career changes in 5-10-year cycles. Likely associated in fields like consulting and therapy.
	Career Pattern Dimensions			
Frequency of Change	Rare	None	Frequent	Moderate
Duration in Field	10+ Years	Life	2-4 Years	5-10 Years
Directionality	Upward	None or Lateral	Lateral	Lateral

Unsurprisingly, non-linear career concepts are poorly understood in fields, such as engineering, where upward mobility and job security within an organization are and have been the traditional model for success (Driver, 1982; 1985). I suggest that variations in career concepts are a confounding factor playing out in the challenge to broaden the participation of Black women in engineering and that we need to investigate what types of career orientations Black women in engineering have in the first place.

After studying workforce trends in engineering industry using the CCF, Kerno (2007, 2008) predicted that engineers of the 21st century may need to shift their career orientations, or adopt more transitory and spiral type career thinking to remain competitive and continue pushing innovation. Accordingly, the overarching research question guiding this study is: *How do the career concepts of Black women engineers influence their career mobility strategies in the tech workforce?* Using Driver's (1985) CCF, I conducted a descriptive multi-case study to describe the career concepts of Black women engineers working in tech, answering each of the following sub-questions:

RQ1: How have Black women engineers entered the tech industry (e.g., where did they transition from, early career motivations, early job search strategy)?

RQ2: What are Black women's values, and how are their career decisions and outcomes (e.g., job changes, promotions) influenced by those values?

RQ3: Why do Black women engineers persist in the tech workforce?

In this study I use the term values to mean the underlying motivations shaping a participant's career-decisions making. I use this term to broadly focus on the subjective values that each person uses to inform their decision making. Specifically, in RQ2, the use of values is more encompassing than what career literature defines as value-based career decision making (Schein, 1996). According to Schein (1990) some individuals anchor career decisions based on a limited set of values which narrowly includes the value of doing challenging work and the larger existential commitment to social good or a social mission. Additionally, I use the term persistence in RQ3, to refer to participants' continued drive and ambition to seek out careers as engineers and not leave the profession. As used, the term persistence encompasses leaving organizations and changing industries or titles intermittently in the pursuit of career success and satisfaction in an engineering capacity. The use of the term persistence is inclusive of both the adaptability of participants to alter their pathway to their engineering career goals and their boundaryless mindset in their approaches to achieving said goals.

The findings reveal important details regarding ways to attract, motivate, and retain Black women engineers based on different career orientations. The findings have implications for human resources by providing them with different criteria to recruit diverse talent and how management and reward systems

can be redesigned to appeal and benefit the career outlooks of individuals with diverse career outlooks (Driver, 1982), possibly revealing that the best person for the job is not necessarily the one who plans to stay with a company indefinitely.

Considering the lack of qualitative insights on Black women's experiences in engineering industry, and ineffective efforts to BP of this specific group, I also used Black feminist thought (BFT) as a theoretical lens to explicate the standpoint of and for Black women (Collins, 1986). BFT is intentionally used to inform both research design, analysis, and interpretations of the study findings. BFT asserts that ways of knowing are not universal but have a fundamental dependence on the knower (Collins, 1986; Riley, Pawley, Tucker, & Catalano, 2009). One of the key tenets of BFT is that it generates knowledge by Black women for Black women. This specific tenant informed my decisions around the data collection methods, data sources considered, the data analysis and processes for validating the findings. Guided by BFT, I prioritized listening to the Black women in the Tech industry already sharing their experiences (e.g., participants were found via online media profiles, media features and interviews).

In the next section, I provide an overview of the innovative research design used to investigate career orientations of Black women working as engineers in the Tech industry. I describe my plan for developing a multi-case study based on secondary data from social media artifacts of Black women working in tech.

1.5 Overview of Multi-Case Study Research Design

I selected a case study methodology because it provides an opportunity to describe the phenomenon of both traditional (i.e., linear) and non-traditional (i.e., non-linear) career orientations and subsequent career strategies from the perspectives of Black women engineers. By using a multi-case study methodology, I will illuminate the varied range of experiences Black women in engineering encounter that influence their engineering career decisions. The phenomenon under study is the career orientations and subsequent mobility strategies employed by Black women engineers in tech, where each woman will represent a case. As with all case studies, defining the case is key and context is important for generalizing findings (Bhatta, 2018; Tsang, 2013; Yin, 2015).

I selected the tech industry as the context for studying Black women's career experiences doing engineering work because technology is comprised of several branches for which engineering work is an integral component (e.g., computing, design, innovation, and manufacturing). I posit that a larger proportion of Black women doing engineering work can be found working in tech industries than tradition engineering industries. Also, of the Black women in the science and engineering (S&E) workforce, approximately 4.5x as many Black women work in computing occupations than in traditional

engineering occupations (Falkenheim et al., 2017). Though the representation of Black women engineers overall is lagging, the reliance of the technology industry on engineering work and the fast-paced growth of the technology field have created a high demand for innovation and engineering skills which creates potential for Black women already in tech to access engineering work and careers that they may not otherwise have had access to.

My study occurs in four distinct phases: (1) build secondary data set; (2) seek consent and construct cases; (3) analyze data; (4) member check findings. My study begins with curating a secondary data set of Black women's engineering and computing experiences in the Tech industry. I leverage social media artifacts and online professional interviews of Black women in Tech to identify potential participants.

1.5.1 Curating a Secondary Data Set.

I used both literal replication and theoretical sampling to identify potential participants. The CCF accounts for both traditional and non-traditional career patterns. As such, literal replication was used to identify participants whose career mobility patterns, if matching theory predictions, could further validate the CCF. As career mobility of Black women is the phenomena under study, attention is given to the different opportunities for advancement in the context of local tech environments. According to Ebrahim & Singh (2017), start-up tech organizations provide markedly different contexts and opportunities for advancement versus a more established organizations in the tech sector. Considering this contextual difference, I also used theoretical sampling to identify women whose technical career journeys began with entrepreneurship (e.g., start-ups) and those whose technical careers began in traditional corporate settings (e.g., at established tech companies). Based on the sampling frame, I built a secondary data set. I made a spreadsheet of 42 potential participants to solicit for the study. The spreadsheet included names, contact information, relevant existing data sources about their careers and links to their social media sites. Some of the oldest data sources date back to as early as 2014 but include content spanning subject's entire life experiences. After compiling the spreadsheet of potential participants, I sought consent from all the women on the list before selecting final participants and constructing individual cases.

1.5.2 Consent & Constructing Cases

For step two, I solicited participants for the study by asking consent to use their publicly available secondary and user-generated data. Sample text for soliciting participants is found in Appendices A-B. Of the 42 women, 15 consented to having their data analyzed for the study. Based on maximum variation I selected 10 participants to construct cases for. For each case, the unit of analysis was the career journey in tech. Using Microsoft OneNote, I constructed chronological timelines of participants experiences in tech. Microsoft OneNote is a cross-functional notebook, that functioned as a qualitative data analysis software for this study. Each case consisted of its own section within a single notebook. Each section

consisted of two pages, one for the career timeline of participants and the other for high-level insights that were the results of case-by-case analysis.

1.5.3 Template Analysis

Next, I use template analysis to analyze each career journey, or case. Template analysis consists of two rounds of coding (J. Brooks, McCluskey, Turley, & King, 2015; King & Brooks, 2016b). The first round consists of deductive coding and a process of constant comparison to analyze the career journeys of the Black women in this study. This process resulted in a set of *a priori* codes to sort each case into career orientations according to the CCF. Next, I conducted a round of inductive coding and constant comparison of each case. During this second step, I detailed how cases deviated from the CCF. Once each case had a rich thick description, I conducted a cross-case analysis to see if any hybrid or new career orientations emerge from that data. The ability to search and navigate across pages and sections was instrumental to identifying similarities and differences among the cases. Additionally, the OneNote software enabled annotation as well as the ability to 'tag' important codes or notes with a symbolic icon. Having a set of codes associated with symbols made identifying similarities, patterns, and relationships among codes and across cases easier as the codes were depicted visually in the software. The resulting themes and thick description of each case and the emergent career concepts concluded the analysis portion.

1.5.4 Member Checking

The final portion, member checking, was done to validate my interpretations of case study findings. I employed visual portraits to participants to get feedback on study findings (S. D. Brooks, 2017; Lawrence-Lightfoot, 2005; Waterhouse, 2007). Based on the different expressions of shared themes (e.g., value-led, and self-directed) across participants, particularly those that were poorly explained by the CCF, I matched participants into empirically derived career profile archetypes as hypothesized by Briscoe & Hall (2006). The career archetypes describe the generic career patterns as well as identifies the common challenges an individual may encounter based on the alignment of their career orientation with that of their organization (Briscoe & Hall, 2006). I then created a visual graphic to summarize the high-level study findings and another visual to describe the individual career archetypes participants data mapped into. In the visual graphic, symbols of values undergirding career decisions as well as psychological attributes common to participants were used to indicate important factors influencing career mobility and subsequent outcomes (S. D. Brooks, 2017).

Solicitation for member checking occurred through electronic communication with Black women in tech, either through email or messaging through their preferred medium (e.g., LinkedIn, Twitter, personal websites). Examples of solicitation and informed consent for member checking can be found in Appendix C-D. The member checking employs graphic elicitation methods as the predominant method

for data collection as opposed to standard interviews (Bagnoli, 2009). The graphic elicitation method involves the use of diagrams, which may either be produced by the researcher or by participants (Prosser & Loxley, 2008). Graphic elicitation was selected because it provides a more holistic view that enhances empathic understanding which can help us pay attention to participants subjective reality in different ways (Walther, Sochacka, & Kellam, 2013).

There were two rounds of member checks. First, I member check with participants, soliciting feedback from the ten individuals who formed each case. This first round of feedback serves as pragmatic validation of both the high-level study findings and the accuracy of the career archetypes. Pragmatic validation examines whether the resulting concepts are compatible with the reality of the Black women's career experiences (Walther, Sochacka, & Kellam, 2013). Based on participant feedback the visuals and thematic descriptions are revised, and new insights are used to co-construct the re-telling of their career experiences. Next, I solicited feedback from other Black women in tech, serving as a form of communicative validation. Communicative validation ensures that study findings are socially constructed and that the researcher's abstract interpretations are grounded in the accounts of the relevant community (Walther, Sochacka, & Kellam, 2013). When soliciting feedback from the second round of member checking with other Black women in the tech industry, I only sought reactions to overall study findings and not the individual career archetypes.

1.6 Significance of this Study

The stagnant state of diversifying STEM fields with respect to Black women highlights a complex real-world problem that needs answers now. The current emphasis on transparency and increasing diversity in the tech industry provides a starting point. The results of this study provide clarity and understanding on the topic of Black women working in an engineering capacity, with specific emphasis on how they move in tech. A qualitative analysis that begins from the real-world level is indispensable to characterizing this phenomenon and developing a better understanding of the nuanced factors underlying the entries and exits of Black women working as engineers in tech. The innovative use of secondary and user-generated data to inform a career study on an otherwise marginalized portion of the workforce provide a prescriptive example of how to handle ethical considerations regarding privacy and access. The measures taken to validate the study findings not only provide additional components of data triangulation, but also exemplify practical use of BFT to inform the research design and interpretation of findings. The duality of this multi-case study to describe and extend career theory make it pragmatic as a research tool. This pragmatism will provide a thorough characterization of the phenomenon and yield

findings into varied versions of tech careers for Black women, and how to get there in terms of career motivation and strategy.

Lastly, this work serves to increase the visibility of successful career strategies and actualized career outcomes by and for Black women in tech. My study on the motivations, specific values, and intentional career strategies, choices and subsequent decisions of Black women engineers provides another form of representation that others may learn from. Additionally, an initial understanding of how Black women engineers move through tech to reach their career goals could be leveraged to improve the management of human resources within an organization(Brousseau et al., 1996; Derr, 1986; Driver et al., 1987; Lazarova & Taylor, 2009; Olson, 1980; Prusak & Davenport, 1998). The potential human resources implications of this study's findings include the ways in which diverse personnel are attracted, selected, rewarded, and retained within the workforce (Brousseau et al., 1996; Driver, 1982; Driver et al., 1987).

1.7 Summary

While most STEM industries have a "commitment to diversity" statement, it is usually lacking a transparent plan or strategy to improve diversity at the company. Additionally, most efforts to improve diversity usually do so in a non-intersectional manner, i.e., targeting minorities or women. Yet, companies are evaluating their diversity efforts based on intersectional data, specifically noting areas for improvement, like the retention and advancement of Black women (D. Brown, 2018; Google, 2014; Guynn, 2018). Despite incremental improvements in the past, current efforts to disaggregate diversity data and increases in transparency and public accountability of stagnant diversity gains are all steps in the right direction. Even better, institutions of higher learning and engineering degree programs are beginning to normalize non-linear pathways to and through engineering and STEM more broadly. However, without a clear understanding of the meaning that career has for Black women or what non-traditional career satisfaction and success in tech entails, we will continue to problematize all factors influencing the career movement of Black women engineers away from traditional career progress. Non-intersectional diversity efforts have and will continue to miss important nuances between (1) factors that push Black women away from the industry altogether (2) factors that limit their pursuit of upward career advancement and (3) factors that pull them closer to the career goals most aligned with their values, desired career development and overall career satisfaction.

While previous research has provided insights and fragments of solutions, most of these studies operate with an underlying assumption that WOC fit more traditional routes to and through the STEM workforce. However, there is evidence to suggest that Black women in tech possess a variety of career orientations spanning both the traditional and non-tradition modes of career progress. Additionally, the increasing emphasis on technology as the basis for engineering occupations and the steady rate of change

in technology have been changing the requirements of engineering careers (Driver, 1982). The fast-paced technology industry is changing career culture, the engineering profession is attempting to diversify its workforce, all while Black women engineers are continuing to make meaning of their careers. More studies are needed to investigate alignment among the various types of career orientations present in workers, the occupational demands of industry and suitable management systems (Driver, 1982).

A way forward in broadening participation is by analyzing the experiences of current Black women engineers in tech, using their career history and user generated data shared online as evidence of their career concepts. This information can be analyzed and ultimately used to better understand how Black women carve out a career in STEM that suits their interests. Using secondary data and social media artifacts I have identified and curated a rich data set on the careers of Black women engineers and intentionally developed a research design that centers the voices of Black women currently in the engineering and computing workforce. The in-depth analysis of their career experiences contributes toward the goal of BP of diverse persons working in the tech industry. If we genuinely value and desire the participation of Black woman in the engineering and computing workforce, a study focused on how Black women conceptualize a career in tech is a timely endeavor. This study highlights varied paths to subjective career success possible for Black women interested in engineering and computing work. This study also serves as inspiration to current and future generations of Black women, who lack the representation and role models in engineering, as vicarious examples of how to navigate and participate in engineering and computing careers to their own satisfaction. For the tech industry, this study can be leveraged to better understand the intentions and pertinent barriers to Black women's continued participation in the workforce and offers considerations for support and reward structures aligned with their career outlooks.

Chapter 2: Literature Review

This chapter provides a detailed discussion of the main topics presented in chapter 1. I begin this chapter by describing the historical context of Black women's lived experiences in the U.S., arguing for a perspective that allows exploration of their struggles and triumphs yet emphasizes empowerment for the next generation of aspiring Black women engineers. Next, I describe in more detail how the career concepts framework (CCF) functions to describe career conceptions of workers globally, arguing for the utility of this framework to help understand the experiences and perhaps unconventional career trends of Black women engineers to broaden the collective perspective of what participation of diverse persons in the STEM workforce entails. I then address the nuances of the relationship among the engineering profession and the technology industry as they relate to this study. I discuss the dynamic relationship between engineering and technology fields, industries, and workers with attention to differences in diversity and representation. Lastly, I discuss the commonality of entrepreneurial trends among Black women in America and in the technology industry, addressing how Black women are pursuing career opportunities, promotion and empowerment through entrepreneurship and what challenges they face in the tech start-up sphere.

2.1 Black American Woman

The dearth of research on WOC broadly and Black women specifically makes the unique experiences of Black women hard to extrapolate. In section 1.3, I called attention to the literature gaps particular to Black women in engineering and how this has further complicated current broadening participation (BP) efforts. In section 1.4, I reviewed the multiple approaches used to BP and highlighted that diverse meanings and enactments of careers was an important component missing from problem characterization. Based on the literature gaps, it is important to study the career meaning and resulting patterns of Black women in engineering from a standpoint that is in clear support of what is known to be true about their experiences. Therefore, I aim for the findings of this study to provide a holistic representation of the experiences of Black women engineers in their respective tech careers. To do this, I must consider what it means to be a Black woman in STEM in America. I begin by describing literature that has explicitly focused on Black women as a group and the ways in which their existence and workplace experiences have been marginalized. I also outline research strategies useful to capture, understand, and describe their reality in terms of what an engineering career is like for Black women.

2.1.1 Womanism: A movement

Black women's discontent with practices grounded in using the experiences of White women and Black men to understand and address challenges faced by Black women is what led to the second wave feminism, also referred to as the Black feminist movement, (Carby, 2007; Collins, 1986; Crenshaw, 1989; Riley et al., 2009). The Black feminist movement was a precursor to major societal shifts, including other notable movements like the civil rights movement, and even impacted new theories in the field of sociology. For example, Black feminist thought (BFT), a social theory attributed to Patricia Collins (1986), is attributed to this movement. BFT holds four key assumptions that are inherent to understanding its working definition. As Collins (1986) outlines:

- The structure and thematic content of thought cannot be separated from the historical and material conditions that shape the lives of Black women, meaning that although BFT may be recorded by others, it is produced by the lived experience of Black women.
- Black women possess a unique standpoint on their lived experiences and there will be common themes shared by Black women collectively.
- The diversity of class, region, age, and sexual orientation that shape women's lives results in a different expression among those common themes; and
- Due to the differing expressions of common themes, Black feminist thought should seek to observe and interpret experiences about Afro-American womanhood that explain those differences.

These assumptions provide a lens from which to address the oppressive, marginalized, and intersection of social aspects of Black women through examining identity, social class, and power structures (Burton, 2017; Collins, 1986). BFT has a long and rich tradition of being produced by women occupying their multiple roles as mothers, teachers, preachers, musicians, etc. and began gaining traction during the civil rights and women's movements (Collins, 1986).

In light of social change, Kimberlé Crenshaw (1989) explains that Black women's experiences are much broader and more complex than discrimination discourse allows us to articulate. Using case law, she describes the de-legitimization and erasure of Black women's experiences of discrimination and inequality in the workplace (Crenshaw, 1989). She coins the term *intersectionality* to give a name to the unique experiences of discrimination toward Black women that were unrecognized and invalidated in the U.S. workplace. Crenshaw articulates the historical instances in which the complaints and experiences of Black women in the workplace were made invisible because they lacked applicability to members of major demographic categories (Crenshaw, 1989). Essentially, courts argued that Black women's petitions and cases for discrimination and inequality either had to be made on the grounds of gender discrimination (e.g., evidence that it was also happening to White women) or on the grounds of race discrimination (e.g.,

evidenced by similar disadvantages or inequalities experienced by Black men); they could not make a case on gender and race (Crenshaw, 1989). Through her work, Crenshaw argues against the insistence to filter the Black woman's experience through a one-dimensional analysis (e.g., gender or race) that obscures their experiences and guarantees that their needs will seldom be addressed. Likewise, the one-dimensional view of career which focuses on their absence from leadership or challenges to advancement without considering alternative views of career success and factors for satisfaction will not result in more Black women collectively participating in engineering or STEM more broadly.

2.1.2 Influence of Race and Gender in the Workplace

Though Black women are hypervisible in the STEM workforce, there is a lack of empirical research that helps us understand their experiences within and expectations of the workforce. The nuances of being a racial and gender minority (i.e., double minority) in engineering are perhaps the reason holistic analyses of the experiences of Black women in engineering are lacking. When the subject of study includes multiple dimensions of social and demographic categories of analysis, as is the case with Black women, a natural complexity arises (McCall, 2005). Gender must be understood in relation to other identities or hierarchies which in turn forms complex intertwining's of identity and oppression (C. J. Brooks, 2012; S. E. V. Brown & Liu, 2018; Crenshaw, 1990; Jordan-Zachery, 2007; McCall, 2005).

There is evidence that workplace environments operate differently for racial and ethnic minority groups, where Blacks perceive significant disengagement. The "chilly climate" is unfortunately a historically prevalent and well-documented reality for Black people in the engineering workforce (Clark Blickenstaff*, 2005; Johri & Olds, 2014; Malicky, 2003; Walton, Logel, Peach, Spencer, & Zanna, 2015). Regarding general workplace environments, a 1996 report on American views of race and discrimination showed that African Americans, more than any other group, were perceived by most of their colleagues to be treated unfairly in terms of promotion and opportunities for training, and targets for discrimination at work (Mays et al., 1996). Black women, however, experience additional challenges at the intersection of multiple identities that have been historically and or socially perceived to be disadvantaged. Workplace studies have found that both gender and race are perceived to influence interactions and relationships important for facilitating career access, social support, and opportunities for advancement (Cech, Rubineau, Silbey, & Seron, 2011; Combs, 2003). Research has found that the interactive effects of race and gender are critical to understanding the position and quality of the participation of Black women in advanced positions of leadership (C. J. Brooks, 2012; Combs, 2003). Additionally, there is evidence that the effects of race and gender are amplified in environments like STEM. While organizations like those in the tech industry are presumably looking to increase the diversity of employees and seeking to hire more Black women, some studies suggest that Black women tend to see being Black and female as negatively

impacting work relationships and advancement opportunities when pursuing non-traditional fields (Cech et al., 2011; Gurin & Epps, 1975).

2.1.3 Challenges for Black women Entrepreneurs

Transitions into entrepreneurship come with expectations of empowerment, as well as enhancement of status and opportunities relative to male counterparts (Ebrahim & Singh, 2017). According to Ebrahim and Singh (2017), entrepreneurship is often a strategy employed by women to overcome career impediments of the *glass ceiling,* or barriers to landing executive roles and election into positions of leadership. While an innovative idea for an app can be a springboard to a CEO or co-founder position for virtually anyone, sustaining a business requires financial resources. For Black women, finding ways to raise money to scale-up and grow their tech companies is one of the most difficult parts.

Since 2009, $424.7 billion was raised to fund tech ventures; however, Black women received just 0.0006%, or $289 million, of that funding (digitalundivided, 2018). While the average amount of money raised in the initial investment round, or seed round, of venture funding for all tech start-ups is $1.14 million, for Black women-led tech start-ups the average is a mere $42,000 (digitalundivided, 2018). As of 2017, just 34 Black women had managed to raise more than 1 million in venture funding (digitalundivided, 2018). Their lower funding is not for lack of qualifications, as a higher percentage of Black women tech founders possess bachelor's degrees (95%) when compared to the national average of tech startup founders (92%) (digitalundivided, 2018). Among Black women tech founders, those with non-STEM degrees secured more average funding to sustain and or grow their businesses, see Table 2.

Table 2. Stats on Black women Tech Founders adapted from digitalundivided's ProjectDiane (2018).

Bachelor's degree Type	**No. of Companies**	**Average Funding Raised**
STEM	70	$627,291.10
Non-STEM	144	$1,516,763.40
Did not indicate degree	13	$346,153.85

While a lack of credit to secure start-up funds and difficulties obtaining capital to grow their businesses is a hinderance, a larger issue is lack of mentors that are a good fit culturally and investors who demonstrate an understanding of the business models and visions that Black women possess (digitalundivided, 2018; Hannon, 2018). Despite these challenges, it was noted that many Black women founders possess characteristics of determination and self-learning (Gines, 2017). Though Black women tech start-ups are not currently prevalent or without significant challenges, these ambitious and often self-taught businesswomen can start and grow companies in environments with limited access to formal

business knowledge, training, and start-up resources (Gines, 2017; Hannon, 2018). The ability to adapt to new and demanding environments, supports the current career patterns of Black women working in the tech industry context but provides little insight into understanding why they would stay or leave, if they can be similarly impactful in their jobs elsewhere. These reasons collectively support the need for this study.

2.1.4 Black women in the STEM Workplace

Researchers Gurin and Epps (1975) conducted one of the earliest theoretical studies on the career choices of African American college women. Their findings indicated that African American college women were attracted to careers in lower-status professions (e.g., social work, teaching) that were female dominated (Gurin & Epps, 1975). Researchers attributed this finding to concerns for discrimination against women in certain fields. The study also found that African American college women considering nontraditional professions (e.g., professions like law, medicine, or engineering where women make up less than 30%) had increased expectations of career difficulties (Gurin & Epps, 1975). When compared to African American women working in traditional professions, African American women in nontraditional careers reported more racial and gender discrimination as well as skepticism from colleagues regarding their competence (Gurin & Epps, 1975).

To illustrate how workplace skepticism could impact a career pattern, I provide the following hypothetical example: One of the sub-types in the CCF is a steady-state individual who is driven by developing competence in their field (Driver, 1985). Typically, steady-state individuals display few, if any, changes in career field and few lateral job transitions (Driver, 1985). A steady-state Black woman engineer, faced with skepticism of her competence, may, in frustration, make more frequent lateral moves or a permanent switch to a different career field (Driver, 1982). Given the evidence that Black women pursue STEM careers with expectations to face career challenges (Gurin & Epps, 1975), I wonder how a competence-driven, steady-state oriented Black women engineer would evaluate a job opportunity or even strategize an unpleasant work environment differently than one with a transitory orientation driven by values related to a social cause? Once we begin to accept the possibility that a variety of career meanings exist for Black women, we can begin to understand their career mobility and STEM workplace experiences more holistically.

In addition to discrimination, another commonality among Black women working in non-traditional fields were their shared beliefs on the compatibility of career advancement and work-family relationships (Burlew & Johnson, 1992). Burlew and Johnson (1992) suggested that the combination of racial and gender bias Black women experienced in the workplace (Gurin & Epps, 1975) and their shared

beliefs on role conflict, differ enough from White women's experiences and beliefs to raise validity concerns about the generalizability of career findings from other women to Black women.

2.1.5 Targeted Approach to Broadening Participation (BP)

To address BP of Black women engineers in the workforce, we need to understand their lived experiences using a holistic framework sensitive to context. Failure to do so could result in significant consequences for that group (e.g., how their low representation in engineering is responded to by others) (Baird & Mitchell, 2014). Efforts not explicitly directed at Black women, or those ignoring the compounded effects of discrimination on marginalized groups, results in a top-down approach where the focus is on singular issues (e.g., race or gender) and provide benefits for marginalized identities at the top of the hierarchy (e.g., White women or men of color) (Crenshaw, 1989).

The Bamboo ceiling is a useful example to illustrate this sort of a top down approach. The *bamboo ceiling* collectively refers to workplace challenges unique to Asian Americans and highlights a combination of organizational, cultural, and individual factors impeding Asian American career advancement (Edwards, 2015; Varma, 2002). The findings of scholarship on the bamboo ceiling have been adapted into career development tools to better understand and develop Asian professionals and has influenced the ways a variety of sectors (e.g., nonprofit, government and universities) discuss and address the challenges Asians and Asian Americans face (Edwards, 2015; Li, 2014). Though Asians are a highly overrepresented minority in STEM, they are virtually absent from positions with management, policy and decision-making responsibilities given their representation in the workforce (Varma, 2002). Varma (2002) argues that the model minority stereotype permits Asians to work S&E roles to the extent that they are overrepresented as working professionals. This overrepresentation grants Asians a higher social and economic status compared to other minorities in S&E organizations, but does not raising them to parity with Whites (Gee & Peck, 2017; Varma, 2002). Despite their overrepresentation as working professionals, Asians are underrepresented in executive roles. In 2015, for the San Francisco Bay area, Asians had the largest negative disparity in representation of executive positions within S&E (25.2%) given their professional representation (47.3%) (Gee & Peck, 2017). To compare, in 2015, Whites made up (43.8%) of professionals in the S&E workforce yet accounted for (68.8%) of the S&E executive positions (Gee & Peck, 2017).

As evidence of the limited benefits of top down approaches, in the tech industry, diversity improvements regarding executive representation for WOC in the San Francisco Bay area have been seen for Asian women only (D. Brown, 2018; Gee & Peck, 2017; Guynn, 2018). Although still below parity with their professional representation in the workforce, Asian women went from 76% below parity to

66% below parity from 2007-2015 (Gee & Peck, 2017). Hispanic women saw no net change in parity for executive representation given professional representation in the S&E workforce and Black women experienced significant loss in the number of professionals in the workforce during that time period, which offsets the appearance of material gains in their executive level representation (Gee & Peck, 2017). Additionally, the gains in Asian STEM career advancement are biased toward Asian men (Li, 2014). In 2015, though executive representation for both Asian men and women are still below parity, Asian men (36% below parity) had almost twice as much representation at the executive level as Asian women (66% below parity) (Gee & Peck, 2017). This bias toward Asian men is likely due to prioritizing singular issues, like nationality or gender, over more compounded discrimination issues facing Asian women (Li, 2014). Specifically, the bamboo ceiling ignores the hypersexualized and ultra-feminine stereotype of Asian women. By ignoring intersectionality, the career leadership challenges of Asian men are addressed ahead of Asian women (Li, 2014).

Yet another, possibly more important, reason to study Black women and not use experiences of other WOC to generalize to the experiences of Black women is the tendency to compare, or even minimize, the oppression of one group to another. The bamboo ceiling anchors on the model minority stereotype, which was created as a counter example to politically active African Americans during the Civil Rights Era (Li, 2014). The model minority myth characterizes Asian Americans as successful, intelligent, passive, apolitical, submissive, and having assimilated into American culture quietly and through hard work (Edwards, 2015). Conversely these seemingly positive stereotypes about Asians also prevent them from breaking the bamboo ceiling and advancing into positions of leadership (Li, 2014). In reference to Black women, the myth of a model minority supports a color-blind system that minimizes the effects of discrimination on other minority groups, essentially blaming other minorities for their own oppression (Li, 2014). Essentially, the top down approach—impacting Asians in (S&E) who have a higher social and economic status afforded by the model minority stereotype—does not benefit other minority sub-groups.

A more effective approach to eliminating discrimination should begin with efforts to address the needs of those who are most disadvantaged, re-thinking and recasting systems of oppression as needed (Crenshaw, 1989, 1990). This bottom up approach toward eliminating discrimination would also benefit those who are singularly disadvantaged (e.g., Black men and White women) and is therefore a more amicable solution that places Black women at the center, reducing compartmentalization of experiences and rather empowering collective action (Crenshaw, 1989, 1990). Considering the unique and understudied experiences of Black women, I plan to utilize Black Feminist Thought (BFT) as an analytical lens when interpreting the data and determining the career concepts of participants in this study. The combined challenge that Black women have faced historically to legitimize their experience of

workplace discrimination and current challenges to gain equitable participation and advancement opportunities warrants a study dedicated to understanding the unique and varied meanings Black women associate with a career.

In the next section I discuss career literature and outline how careerism aided in framing my study on Black women's engineering experiences in the tech workforce. I also delineate how the findings of this work will contribute to the development of career theory.

2.2 Theoretical Foundation – Careerism

Careers have been studied from a variety of disciplinary perspectives (e.g., psychology, sociology, anthropology, economics, geography, political science, history) and through a multitude of approaches, contributing to a richness of *career studies* as a field (Baruch et al., 2015). The increasing interest and scholarly growth in the field of career studies has led to a plethora of terms and concepts yet lacks an agreed upon career model and overarching theory. Systematic, historical reviews are well underway, aiming to bring clarity and coherence to the career studies field (Baruch et al., 2015). In recent years, scholars, or careerists, have been working to identify the terms that shape the career discipline and determine new directions of the field. As careerist work to identify and sort out terms and concepts that will be pillars of the discipline (as opposed to mere fads), I explicitly incorporate the perspectives on careers from a historically understudied class of workers in hopes to add to the comprehensiveness and robustness of the evolving career theory.

A consensus among careerist is that, prior to the 1990's, careers were viewed among the general populace in a traditional manner, meaning that a person moved up within an organization's hierarchy until retirement (Baruch et al., 2015). However, a combination of social, political, and most relevant, technological changes have caused changes to the traditional career structure. Globalization and downsizing have led to marked changes in jobs and overall organizational structure (e.g., telework and travel), each having significant impact on the context in which careers are enacted (Arnold, 2011; Buzzanell & Goldzwig, 1991; Driver, 1982, 1985; Herman & Lewis, 2012; Lazarova & Taylor, 2009).

Engineering as a field fits the more traditional view of careers and has, to an extent, been out of phase with societal career trends since the 80's (Driver, 1982, 1985). The misalignment of engineering career culture and the varied career concepts that individuals aspiring to be engineers possess is hampering BP efforts: engineering management needs to be redesigned to fit both the strategic needs of organizations and the prevailing career outlooks of the diverse personnel it wishes to attract (Driver, 1982). Brousseau et al. (1996) published a paper in a management journal discussing the career pandemonium. They describe a misalignment between organizations and individuals, which is essentially the argument I and other scholars have highlighted regarding the challenge facing the engineering

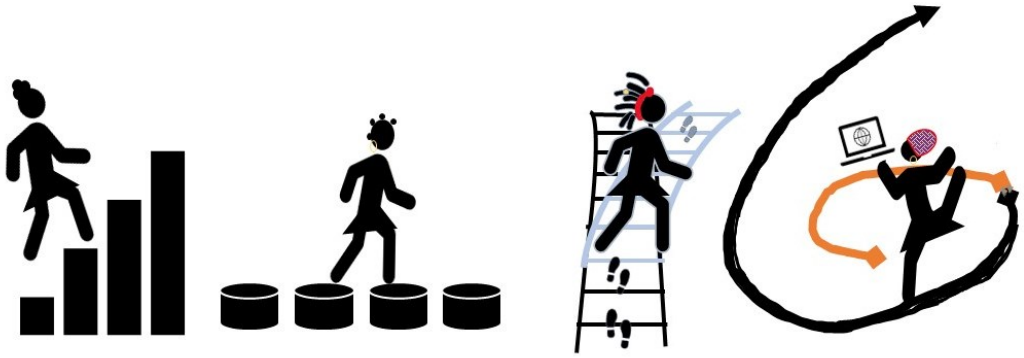
workforce and efforts to BP of Black women. A 2015 study by Ross & Godwin, further supports that there is indeed a misalignment between the engineering profession and individuals: “engineering, as a discipline, aims to solve a diversity problem in the engineering without an adequately understanding the true breadth, and depth of the problem (p.1)”. As mentioned, while the field of career studies is concurrently working toward an overarching theory, I aim to add perspectives of Black women to the discussion. By examining the extent to which Black women map to one of the more robust career frameworks, and how the current climate of the tech industry impacts their career enactment, I illuminate the strategies and patterns underlying their participation in the workforce.

2.2.1 Understanding Driver’s (1985) Career Concepts Framework (CCF)

As defined by Driver (1982), career concepts are enduring inner views of the meaning associated with a person’s career. In industrial psychology, the two dimensions used to understand *concepts* are (1) content and (2) structural or physical components. In a career concept sense, the content dimension is concerned with career choice and motives. The structural dimension focuses on how an individual combines content information to factor differentiation (e.g., when a career is chosen), integration (e.g., permanence or how long), and flexibility among parts (e.g., direction of change: upward, lateral, or downward) (Driver, 1985). The structural dimensions of career movement were identified through work on career stage theories (Baruch et al., 2015; Flaherty & Pappas, 2002; Olson, 1980; Prince, 1979; Super, 1980). An interesting facet that distinguishes Driver’s career work from other career theory is the combined focus on the psychological processes as well as the structural components that one uses to construct meaning of a career: most career theories focus on either the content or the structural dimensions of a career. Driver (1985) studied both dimensions to reveal common patterns resulting in four main career concepts (e.g., linear, transitory, spiral, and steady state).

Although not initially part of the CCF, work by Prince (1979) found motivational factors (e.g., values) correlated meaningfully with the CCF to allow two possible subtypes within each career concept, indicated by the two values listed under each concept in Table 3. For example, work by Olson (1980) supports that two types of steady-state seem to exist. One type of individual with a steady-state career orientation is characterized by a focus on job security while the other is characterized by a focus on a display of competence, more commonly attributed to creative professionals who grow by increasing competence within their selected field (Driver, 1985; Olson, 1980).

Table 3. Career Concepts Framework- adapted from Driver (1985)



Career Orientations				
	Linear	Steady-State	Transitory	Spiral
	Psychological and Physical Career Dimensions			
Values	1. Power 2. Achievement	1. Security 2. Competence	1. Variety 2. Identity Search	1. Growth 2. Nurturance
Frequency of Field Changes	Rare **	None	Frequent	Moderate
Duration in Field	10+ years	Life	2-4 Years	5-10 Years
Directionality	Upward	None or Lateral	Lateral	Lateral

The ranking of the values in Table 3 are indicative of career motivations that dominant the career concept sub-types (Driver, 1985; Olson, 1980). Combined with the correlating motivational factors, the CCF provides a blend of self-concept, motivation, and three components of the physical career dimension to classify an individual according to their career patterns. These patterns exist globally and unveil other models of career success. Each of the four identified career concepts offers a widely held and subjectively valid view of the meaning of a career and were empirically tested and held true on a large international sample of workers (Driver, 1985).

2.2.2 Justification for Selecting CCF

After a review of career literature, I selected Driver's (1985) CCF because the themes and patterns proved useful in describing the short tenure and lateral, rather than upward, occupational transitions common to Black women engineers in today's workforce. While most career theories focus on the internal psychological structures guiding an individual's career choices, other theories attend to the fit between inner processes and organizational factors (Brousseau, Driver, Eneroth & Larson, 1996). Even less attention is paid to the 3-way fit between an individual's career orientations, that of their organization, and external societal forces (e.g., current workforce demographics, employment rates, etc.). Driver used the CCF to develop a model that examined and predicted trends in individual/organizational career

patterns and social trends to elucidate a widening gap between social trends of the 1980's and 21st century workforce (Arnold, 2011; Driver, 1985). Basically, the career concept model predicted that, with the dominant linear career concept of the baby boomers (e.g., those born 1946-1964), all levels of management would become saturated: middle management positions only beginning to open in 2010 and upper management not see vacancy until about 2025 (Brousseau, 1990; Driver, 1985). The model also predicted that those born in 1965-1980 would possess a dominant linear career concept, which in turn generated expectations of high mobility (e.g., advancement) (Brousseau, 1990; Driver, 1985). However, the finite number of management positions were and still are being occupied by the previous generation (e.g., baby boomers). It was concluded that with institutions of higher education and professional organizations (e.g., engineering) still fostering the linear career concept, both individuals and organizations may continue to experience conflict with workforce trends in the U.S.; this conflict was predicted and coined *linear career crisis* by Driver (1985) (Brousseau et al., 1996).

With respect to STEM careers, the forecasts of the increasing dependence on technology led Driver (1982) to suggest that engineering careers stressing linear upward movement were headed for problems. The proposed solution to the crisis was to have more workers with a non-linear career concept. However, non-traditional career concepts among workers raises the concern for adapting career management systems (Brousseau, 1990; Driver, 1982). He states that "tragic misuse of human capacities with resultant organizational failure (p. 5)" occurs when the prevailing career culture of an organization does not fit well with individuals possessing divergent career concepts (Driver, 1982). Driver (1982) applies the CCF to examine future trends in engineering careers and suggests several career management systems designed to reward non-linear career concepts.

In his work, Driver (1982) provides examples of potential career patterns from frustrated individuals who experience misalignment with their organizations career culture and their individual career concept, echoing the current trends of Black women in the engineering workforce. Attributing the challenges of BP and advancement of Black women engineers to racial and gender discrimination is too flat of a characterization to actualize BP efforts. A major component in the challenge to BP of Black women engineers that goes under addressed is a mismatch of organizational and individual career concepts, which at times is further complicated by discrimination and biases in hiring and promotion.

I attribute the accuracy of the career concept model predictions to current societal career trends of Black women to the robustness of studies used to inform the CCF. Using a range of career studies that spanned multiple continents, career fields, races/ethnicities, genders, and generational age of college students and workers, Driver (1985) tested the four major themes that accounted for the bulk of variations in career patterns. The main critique of other career frameworks and models are either an underlying negative connotations of non-linear career patterns, casting them in a deficit role; associations with semi-

skilled or low competency workers; or lack of flexibility to account for changing circumstances and consideration for social context(Arnold, 2011; Baruch et al., 2015; Buzzanell & Goldzwig, 1991; Driver, 1982, 1985; Lazarova & Taylor, 2009; Prince, 1979). Additionally, the concepts and sub-types within the CCF are broad enough to classify career patterns that may not have been available to study at the time. Given the parallels of career patterns for non-linear career outlooks and current trends among Black women engineers in STEM, I used the CCF to guide the categorization of the varied career orientations found in my study.

2.2.3 Evidence of Disciplinary Shifts in Engineering Career Concepts

Broadly speaking, the engineering profession normalizes the more traditional, linear, and steady-state career concepts (Driver, 1982). However, there is evidence of disciplinary, and perhaps industry-related, differences regarding norms in engineering career concepts. For example, the median tenure (e.g., number of years with a given organization) of software engineers at large companies in the San Francisco area is 2.3 years (HackerLife, 2017). In high-tech geographical areas like Silicon Valley, this short tenure is reflective of the competitive market and in-demand skills of software engineers and fosters frequent lateral occupation shifts for increased salaries (HackerLife, 2017). Moreover, software engineer's tenure with a company is directly correlated to company size, where smaller companies have an even harder time retaining their workforce (HackerLife, 2017; Souza, Malta, & De Almeida, 2017). When compared to the median number of years for employees in professional occupations across the country, those in engineering and architecture broadly have a median tenure of 5.7 years with a given company (Statistics, 2018). Though these statistics are devoid of any race or gender data, I find it contradictory that Black woman engineers leaving large tech companies (e.g., like Apple or Facebook) within a year or the engineering profession broadly within the first five years (Fouad & Singh, 2011) is evidence of a "diversity in tech" problem. The already low representation in the tech industry coupled with the hypervisibility among the few Black women engineers in the workforce has possibly led us to problematizing career patterns (e.g., lateral moves to secure better pay) that are a norm for the competitive industry in which they work.

Given the norms of the industry, it is quite possible that many Black women engineers in tech possess non-linear career conceptions. If you consider patterns of non-linear career orientations and societal factors like the growing demand for diversity in tech and the linear career crisis prediction, then the high- turnover rates, industry exits, and lack of Black women in advanced engineering career positions in tech is less surprising. However, to date, the varied career orientations of Black women engineers in tech are not well explored. The dearth of literature concerning non-linear and non-traditional career patterns leaves many questions that simply lack the appropriate data to answer.

2.2.4 Non-Linear Careers for Women in Engineering and Computing

A recent systematic literature review on the status of women in the engineering and computing workplace stated that there is relatively little research that explores why women leave engineering and computing fields or, more importantly, under what conditions they leave (Corbett & Hill, 2015). In attempts to track changes in workforce diversity, researchers found that of women who leave engineering occupations, half of them leave the corporate sector for similar technical jobs elsewhere and the rest moved to jobs outside of STEM altogether (Hewlett et al., 2008). Jobs dependent on technology face the threat of obsolescence, requiring workers to seek constant renewal of technical skills to creatively deal with complexities that arise as technology evolves (Driver, 1982). This trend in technology dependence supports the need for more individuals and systems with non-linear career orientations, where skill variety and growth are valued over job security, competence, power, and achievement (Driver, 1982).

According to the CCF, the women who leave organizations for similar jobs or move to jobs outside of STEM in under 10 years could fit within the transitory or even spiral career concept. The transitory concept consists of frequent changes with no need for stability or upward movement, rather seeking variety and challenge as career motives. However, the highly structured engineering career culture shows favoritism toward more predictable or stable career concepts such as steady-state or linear (Driver, 1982). Despite the favoritism of the more familiar concepts, individuals with transient career concepts are speculated to thrive in high technology environments where stability is extremely low (e.g., software engineering in Silicon Valley). Because career cultures are merely organizational extensions of career concepts, it is suggested that tolerance of non-linear career concepts and cultures will require support and understanding from the top (e.g., management) where linear orientations are most prevalent (Driver, 1982).

In another study, researchers administered a survey to engineering alumni to uncover factors that lead to women's decisions to leave or stay in engineering careers (Singh et al., 2013). The survey was designed to assess factors that could influence an engineer’s likelihood of leaving the field—such as vocational interests, job and career satisfaction, work-family conflict, training and development opportunities, workplace support mechanisms and initiatives, work environment, as well as commitment to employer and engineering profession. Of the 5,500 respondents, more than half were currently working as engineers, 25% had worked as engineers but left, and another quarter had engineering degrees but never worked as engineers (Singh et al., 2013). For those that had worked as engineers but left, some of the known factors were lack of mentoring, mismatch of interests, and difficulty balancing work and family responsibilities (Corbett & Hill, 2015; Singh et al., 2013). Without knowing the type of job or industry these women moved onto, it is difficult to discern career concept but the mismatch of interests and role conflict are indicative of non-traditional career concepts (Buzzanell & Goldzwig, 1991; Clark

Blickenstaff*, 2005; Hackett & Betz, 1981; Herman & Lewis, 2012; Larsson & Driver, 1993; Rincon & Yates, 2018; Wang et al., 2013). In another study, the most important reason cited for women who left engineering was a change in career or professional interests (Frehill, 2012), which fits within the spiral career concept another non-traditional orientation.

Alignment between individual interests and values are an important influence on career patterns. In a study measuring various types of persistence among college engineering majors, Cech et al. (2011) found that engineering students who felt that their interests and values fit the career culture of engineering were more likely to intend to be an engineer five years after graduation. The study essentially found that career-fit confidence was strongly and positively related to future career plans (Cech et al., 2011). Other measures of persistence, such as expertise confidence, or confidence in skills to fit the engineering field, had little impact on plans for a future career in engineering (Cech et al., 2011). Combined, the findings of Frehill (2012) and Cech et al., (2011) highlight the importance of understanding the individual (e.g., their interests and values) to fully comprehend their intentions for an engineering career and how that measures up to or aligns with what they experience when working for an organization. In the event there is a mismatch, it is imperative to study how that individual goes about re-aligning their career decisions and strategies with their expected or desired career outcomes.

In his work, Driver (1982) stated that a systematic survey of career concepts among engineers would be useful to indicate the types of management systems suitable for existing engineers. I agree; however, we have not explicitly investigated the career orientations or patterns of Black women in engineering broadly enough to achieve those goals. Fortunately, the recent focus on diversifying tech has placed Black women's engineering career trends in the forefront of the media, a visibility that makes studying their career concepts by analyzing their patterns possible. My preliminary work (e.g., building the secondary data set) suggested that most Black women engineers do possess some form of transitory or other non-linear career conceptions. Given that there are several other conceptualizations of what a career means *to* and *for* people, how might we characterize the issue of career advancement of Black women differently if we did not operate under the assumption that everyone defines and pursues career success the same? If we understood that gender and racial bias in STEM workplaces function as barriers for Black women with traditional, or linear, career aspirations, how do these challenges influence those with other types of career orientations? The patterns and themes underlying different trajectories is what I hoped to uncover in my study of variations in Black women's engineering career conceptions that culminate in the diverse careers they enact in the tech industry. An analysis of individual career journeys and the details they reveal will provide context to understand the career decisions Black women make. The findings will be useful for informing management practices of different career outlooks as well as

how engineering and the technology industry as whole can improve their culture to welcome different career orientations.

In the next section I engage the reader in a discussion of the interrelated and symbiotic relationship between engineering and technology. While I do not attempt to delineate hard boundaries around the terms engineering and technology, I do aim to outline how closely they operate alongside terms like industry and workforce.

2.3 Relationship between Engineering & Technology

The interrelationship of engineering and technology can be summarized in that they both share a central mission: to solve practical problems and answer "how to" questions. For some, engineering is considered a more refined area of study and professional endeavor in the broader discipline of technology (Dugger Jr, 1993; Sheppard, Colby, Macatangay, & Sullivan, 2007). Engineering can also be thought of as a vehicle for delivering technological advancements to drive civilizations (Dugger Jr, 1993). Some define engineering without a mention of technology. Providing a formal definition, the Accreditation Board of Engineering and Technology (ABET) says the following of engineering:

> The profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically the materials and forces of nature for the benefit of mankind. (ABET, as cited in Dugger Jr, 1993).

Essentially, engineers use and make technology and technologist utilize things that were engineered. In Figure 1, I provide a Venn diagram to highlight the practical ways in which engineering and technology are both similar and different.

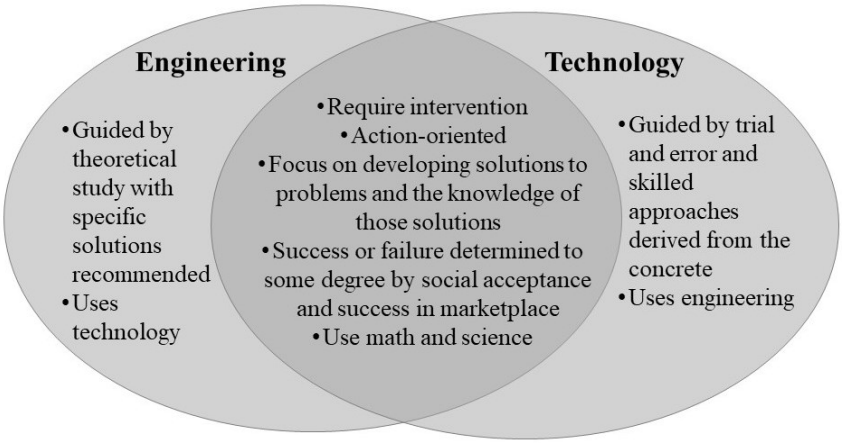


Figure 1. Comparison of Engineering and Technology adapted from Dugger Jr. (1993)

For this study, I am focusing on a sub-group of the engineering workforce in the technology industry. The engineering workforce simply refers to the people engaged in or available for engineering work in a country, area, company, or industry (Merriam-Webster, 2019). The technology industry is defined as category of companies with ownership, and assets relating to research, development and/or distribution of technologically based goods and services and used interchangeably with technology sector (Merriam-Webster, 2019). In the next section, I specifically address employment opportunities of engineers in the technology industry and the types of occupations included for consideration in this study.

2.3.1 Employment Relationship of Engineering and Technology

The fast-growth, innovative nature, and high demand for skills associated with the tech industry combined with the symbiotic relationship in engineering has led to a steady growth in tech jobs for those with traditional engineering degrees and closely related degrees (e.g., computing) (Corbett & Hill, 2015; Hill et al., 2010). Because an engineering (or computing) degree can qualify an individual for a range of jobs in the tech industry, I am including computing occupations in my definition of engineering workforce. A cursory internet search using the term *Tech Jobs* revealed a host of occupations that either had engineer in the title or required an engineering degree or computing degree. In Table 4, I present some examples of the types of engineering occupations in the tech industry that were considered for the Black women included in this study. While some of these jobs listed a degree in engineering, computer science, or a closely related field as their minimum qualifications, others listed minimum years of experience and knowledge of specific software or skills for job requirements.

Table 4. List of Computing and Engineering Occupations Returned for Tech Jobs, Indeed.com (2019)

Engineering & Computing Occupation	
Computer Hardware Engineer	Python Developer
Computer Vision Engineer	Full Stack Developer
Electrical and Software Integration	Database and Systems Administrators
Engineer	IT/Systems Engineer
IT Infrastructure Engineer	Network Architects/Engineer
Computer and Information Analysts	ISV Tech Evangelist
Software Engineer/Architect	Cloud Engineer

Regarding accessibility, the technology industry appears to provide additional venues to participate in the engineering workforce through self-taught skills and certifications so long as the minimum requirements of experience are met. Furthermore, the smaller start-up companies that are

prevalent in tech have less competitive entry-level requirements for software engineers than some of the more notable high-tech corporations (e.g., Google), making them optimal avenues of entry for self-taught software engineers or those with more informal educational backgrounds (Souza et al., 2017). The technology industry essentially offers an avenue to the benefits of an engineering occupation without necessarily demanding the formalized education and licensing often required in traditional engineering industry and practice. As a result, the 10 Black women engineers selected for this case study include those with formal engineering degrees working at large tech corporations, those with non-STEM degrees who have built tech start-ups and even some with no formal degree now working as software engineers. These 10 women were selected for maximum variation and to demonstrate differences in access, career concepts, mobility strategies and outcomes. I hope to illustrate that traditional careers nor a formal education, let alone an engineering degree are essential for Black women to fully participate in or contribute to economic growth through work as engineers.

2.3.2 Entrepreneurship as a Career Concept in Tech

Although the growth in businesses owned by Black women is rapid, many of their entrepreneurial endeavors are led by necessity rather than the desire to seize a market opportunity (American Express, 2018; Hannon, 2018). As a result, many Black women businesses fall within service type industries, like hair salons, catering, and childcare, but there is optimism that a growth in tech and engineering type business is soon to follow (Hannon, 2018). Combinations of the widening racial pay gap, higher unemployment rates, and long-term unemployment were an impetus for the rapid growth in entrepreneurship among Black women collectively (American Express, 2018). While necessity entrepreneurship tends to peak when job opportunities are low and drop when job creation is higher, the rate at which Black women started or stuck with businesses remained high as the economy improved (American Express, 2018). This represents a combination of entrepreneurship based on both necessity and opportunity.

Entrepreneurship falls within the transitory career concept in the CCF. The growth among Black women-owned tech startups is further evidence that some Black women in the engineering workforce possess non-linear career concepts. As mentioned previously, corporate engineering culture is not particularly supportive of transitory individuals (Driver, 1982), which is why some transitory individuals leave corporate industry for technical jobs elsewhere (Hewlett et al., 2008), or seek market opportunities and pursue entrepreneurship. Unfortunately, how entrepreneurship is used as a career strategy by the historically marginalized and underrepresented Black woman is not well explored. Although entrepreneurial pursuits come with their own set of challenges, perhaps the opportunity for empowerment, agency, and advancement (Ebrahim & Singh, 2017) align jointly with the values of variety and identity

search in the sub-types of the transitory career concept (Driver, 1985; Olson, 1980). My study provides insight into these assumptions with respect to Black women initiating both for-profit and non-profit tech ventures as well as illustrates the variety of ways some Black women in the engineering workforce construct their careers in tech.

In the next section I describe some of the specific challenges Black women tech founders face in realizing their entrepreneurship goals.

2.3.4 Black women in Tech and the Economy

The push to graduate more Black women engineers and broaden their participation in the workforce is in part motivated by a desire to remain competitive in the global economy (Galloway, 2004; Noeth, Cruce, & Harmston, 2003; Rincon & Yates, 2018; Roberts & Ayre, 2002; Sargent Jr, 2017). To that point, Black women are currently the fastest growing demographic of entrepreneurs in the U.S. (American Express, 2018; Hannon, 2018). Interestingly, the majority of Black women tech founders (~63%) possess non-STEM degrees and reported never having worked for a tech company (digitalundivided, 2018). In 2018, Black women-led tech startups accounted for 4% of the tech startups, or 0.112% of all firms in the U.S. (digitalundivided, 2018). Their growth more than doubled during a two-year time period, increasing from 88 start-ups in 2016 to 225 in 2018 (digitalundivided, 2018). Though the sheer number of tech startups account for a relatively small portion of all firms in the U.S. (2.8%), their impact on the economy cannot be overstated (Wu & Atkinson, 2017). Tech startups create more and longer-lasting jobs than other startups and pay more than three times the wages (Wu & Atkinson, 2017). When looking across the typical indicators of economic potential and growth (i.e., job creation), it appears that entrepreneurship in the tech industry is an endeavor worth promoting.

2.4 Summary

This chapter highlights the ways in which Black women's workplace experiences have been obscured due to a tendency to try and understand their lived experience through the lens of White women or Black men. I provide evidence that, as a group, Black woman share workplace experiences, values, and stereotypes that differ enough from White women and other groups of WOC, warranting studying them in their own right. However, in explicitly studying Black women and their careers, I advocate for disrupting the monolith and use a framework that embraces understanding the in-group variation Black women can have in career meaning and enactment.

I describe the career concepts framework (CCF) in detail and outline how it has been used to predict trends in engineering careers. In describing the CCF as it relates to engineering, I illustrate how a mismatch among individual career concepts and engineering culture can lead to frustrations among employees. I then provide evidence and arguments to suggest that current employment trends among Black women engineers exemplify such frustrations and map to existing, albeit non-traditional career

concepts. Though they are poorly understood and ill-supported, Black women engineers with non-traditional career concepts appear to be finding ways to participate in engineering.

To that point, this chapter also touches on the symbiotic relationship between engineering and technology and how that relationship has created accessibility for individuals with non-traditional career orientations and backgrounds to participate in the engineering workforce. The fast-paced nature and high demand for skills in tech appear to have created avenues of access for Black women more readily than traditional engineering industry. One example is the national pattern of entrepreneurship among Black women broadly, and the fact that for Black women owned tech startups, the majority possess non-STEM educational backgrounds. In addition to discussing current statistics on the growth of Black women tech founders, I highlight the contribution that tech start-ups have on the U.S. economy.

Lastly, if Black women engineers exist across the spectrum of career orientations in the CCF, I speculate whether those with linear career orientations use entrepreneurship in tech as a career strategy to combat challenges to career advancement in the corporate tech world (e.g., fast track to CEO). I also present the likelihood that entrepreneurship is the result of a genuine non-traditional career orientation for those driven by variety or growth, as evidenced by most Black women tech founders with non-STEM backgrounds who have never worked in tech. I end this chapter highlighting the fact that efforts to BP are more readily focused on graduating more Black women with engineering or STEM degrees than investing and supporting career development and variations in individual career motivations. Yet there is evidence that Black women with non-traditional career concepts are more conducive to the country's economic growth and for some, to participate successfully in the engineering workforce an engineering degree is non-essential.

Because organizations are tasked with identifying talented employees and managing them to maximize firm performance, I argue that a key part of management is a holistic understanding of the varied ways in which individuals are motivated and choose to apply their knowledge to enact their careers. This chapter demonstrates the need for a research study that focuses on understanding the varied career conceptions of Black women engineers to better understand what their preferred participation looks like. The insights could be adapted into career self-development guides to aid navigating a satisfying engineering career for aspiring Black women based on lived experiences of Black women who are similarly motivated. Similarly, the findings could be leveraged into guidelines for management on how to readily attract, support and reward a more diverse workforce.

Chapter 3: Research Design

3.1 Introduction

The purpose of this multi-case study was to describe and explain the varied career orientations of Black women working as engineers in tech and subsequently link those career orientations to their career outcomes. The overarching research question for my study was as follows: **How do the career concepts of Black women engineers influence their career mobility strategies in the tech workforce?** To answer this overarching question, I focused my study on the following sub-questions:

RQ1: How have Black women engineers entered the tech industry (e.g., where did they transition from, early career motivations, early job search strategy)?

RQ2: What are Black women's values, and how are their career decisions and outcomes (e.g., job changes, promotions) influenced by those values?

RQ3: Why do Black women engineers persist in the tech workforce?

To answer these questions, I used the career concepts framework developed by Driver (1982, 1985) with Black Feminist Thought (Collins, 1986) as a theoretical lens combined with case study research approach (Yin, 2009). BFT was used to guide my research design and inform my decisions related to data sources, participant inclusion criteria, and data analysis. Specifically, I used an innovative methodology to source existing secondary and user-generated data and a multi-case study design to explain the various reasons and incentives Black women engineers have for leaving organizations and how they go about exercising mobility in their careers.

In this chapter, I describe the innovative research design used to answer the research questions. I cover my positionality as a researcher, provide an overview of the multiple-case study design, and detail the process used for sourcing the secondary data. I then describe the construction of each case, data analysis, and procedures for soliciting and collecting feedback from participants and other Black women in tech. Finally, I discuss measures of quality and limitations of study findings.

3.2 Positionality

Positionality, sometimes referred to as reflexivity, is a recognition of one's life experience, identity, and worldviews (Begoray & Banister 2012). It is imperative in qualitative research for the researcher to discuss their positionality because it influences six fundamental aspects of the research to include the topic, epistemological and ontological stances, methodology, relation to participants, and interpretation of findings (Begoray & Banister 2012 (Secules et al., 2021). I approached the acknowledgement of my own positionality by reflecting about and then responding to the following two questions: (1) How do you

understand the research process? (Lacy, 2017) and (2) Who are you and how do you relate to the participants in your study? (Lacy, 2017). I discuss the answers to each question in the next two sections.

3.2.1 Philosophical Worldview

For me, the research process is synonymous with acquiring new knowledge. Understanding my views on knowledge acquisition involves a recognition of two philosophical branches: 1) claims regarding the nature of what is real–*ontology*; and 2) claims regarding what can be known about that reality—*epistemology*. Because one's stance on reality influences how it can be studied, both ontology and epistemology have implications on the research findings. Once a stance on reality is taken, then the method, validity, and scope of studying that reality should follow in alignment. When conducting qualitative research, an understanding of the researcher's views on reality and the subsequent steps to investigate that reality can help the reader make decisions on the logic and reasonability of the findings.

Limited realism is the philosophical view I brought to this study. From an ontological stance, I am a realist who believes there is an objective reality outside of human interpretations (King & Brooks, 2016a). However, my epistemological stance aligns with that of a constructivist; in other words, I believe that human understanding of reality is limited by our position, where culture and social forces have just as real an influence on our experience(s) and behavior(s) as physical phenomena (King & Brooks, 2016a). As a researcher with a limited realism philosophical lens, I sought to further develop the career concept framework and its applicability to Black women in tech. In the next section, I discuss who I am as it relates to the participants chosen for this study.

3.2.2 Connection to your participants—Shared commonalities, identities, or experiences

As a mixed-race person and dual national German American, I grew up in a biracial household and was raised in Germany. Presumably, unlike the participants in this study, I did not have an inherent understanding of what it is like growing up in a Black American household, or with a Black mother. Moreover, I lacked an understanding of growing up with the historic context of racial tension and disparities, some still blatant, in the U.S. This lack of context makes me somewhat of an outsider in relation to the group of women I am studying.

Like the participants in my study, I have experienced all my post-secondary STEM education and or training in the U.S. However, unlike the participants, I have spent the past 6 consecutive years (2013 – 2019) pursuing graduate-level engineering education full-time and have yet to gain industry experience. I opted for research-based experiences as opposed to co-ops or internships because I was interested in the academic route with aspirations of becoming a faculty member. The lack of industry experience presents a limitation to my understanding of working in corporate America, let alone as an engineer and WOC.

Economic trends, media reports, literature, secondary evidence from former peers all informed my collective knowledge of Black women engineers in the workplace.

The media has painted the short tenure of Black women engineers and their low representation in industry leadership as a problem rooted in workplace discrimination. I noticed discrepancies between the agency of Black women engineers in the narratives found in the literature compared to the vicarious career experiences of my peers in the workforce. Mainly, I noted different, more positive, connotations associated with my peers' discussion of changing jobs and pursuing alternate STEM careers that were not readily reflected in the reports that were being written about Black women engineers. It was as though the media detailed the factors pushing Black women out of STEM and my peers were sharing the factors and opportunities that were pulling them closer to their dream job. Given the evidence that Black women are aware of challenges they may potentially encounter before entering the STEM workforce (Cech et al., 2011; Gurin & Epps, 1975), it is unlikely that they choose to participate without conscious strategies to navigate expected difficulties. Accordingly, the purpose of my study was to describe the variations in Black women's engineering career orientations and provide details about their mobility strategies to illuminate the types of career decisions making strategies that yield participant satisfaction and alignment with underlying career motives. Ultimately, my study aims to fill in gaps on understanding how and why Black women engineers transition throughout the tech workforce the ways in which they do.

In the following sections, I describe the implications my views had on my method choice, the data collection and analysis plan used to answer my research question(s).

3.3 Research Design

Qualitative research should be used when focusing on understanding what is unknown or not yet fully explored about groups or individuals, lending itself to addressing a literature gap (Creswell, 2013). By purposefully describing the variations in Black women's engineering career orientations, I advanced the understanding of how Black women construct meaning in terms of their careers. Qualitative research is well suited to address my overarching research question considering the lack of concentrated literature on engineering workforce experiences of Black women and is likely to provide a map of analytical discovery surrounding multiple meanings and enactment of *careers* for this population.

Specifically, I used case study methodology to understand how Black women engineers constructed meaning of their career in tech. The case study methodology places emphasis on context, and its use in qualitative studies is ideal for studying a phenomenon with respect to multiple realities. According to Yin (2012), all case study research begins from the compelling desire to gain an in-depth understanding of a single or small number of cases studied in their real-world context. The details of a case study should aim to produce a complex yet invaluable understanding of the case that yields new

learning about real-world behavior (Yin, 2012). Case study methodology is flexible and has lent itself useful in both quantitative and qualitative social science research. Unlike many other types of purely qualitative methodologies (e.g., phenomenology), the case study methodology does not delineate rigid methods for data collection and analysis. The varied use of case study research has resulted in a multitude of theoretical streams informing its methodology.

Approaches to case study research are largely dependent on the epistemology of the researcher. There is a tendency in the literature to omit an explicit mention of the researcher's philosophical positionality, which bears on their application of case study research. This omission results in a variety of case study research where the methodology is applied differently without explanation, creating problems in understanding and interpreting the multitude of case study approaches (Bhatta, 2018). The variety of approaches, concerns for research designs, and implications of case study findings in the literature are a direct reflection of the varied philosophical stances of researchers (Bhatta, 2018). For example, some researchers argue that Stake has a more traditional constructivist positionality and approach. Yin's positionality is more of a realist, making his approach to case study design more procedural and objective (Bhatta, 2018; Yin, 2012, 2015). I used Yin's approach to case study to guide this dissertation work. His realist stance, along with the role of case study findings for theory generation, aligned with my own positionality as a researcher and addressed the theoretical aims of my study to extend the career concepts framework (CCF) as it pertains to Black women.

Yin's approach to case study is a blend between both qualitative and quantitative paradigms, especially considering his use of theory in pre-research as well as theory generation from case study findings (Bhatta, 2018). Yin's approach reflects his realism. Evidence of his realist stance are in the emphasis placed on using multiple methods and triangulation to 1) study reality as close as possible and 2) circumvent errors as he views all forms of measurement as imperfect (Harrison, Birks, Franklin, & Mills, 2017; Yin, 2012, 2015). Despite Yin's procedural and objective approach to case study design, his recognition of the importance of interpretivist elements when studying cases in context make a multiple case study useful to clarify obscure theoretical relationships from varied Black women's perspectives and useful for extending theory of career concepts for minority women (Harrison et al., 2017).
According to Yin (2015), a criterion for case study design is the use of theoretical propositions that aid in providing analytical generalizations once the study is completed. Unlike statistical generalizations, case studies can provide analytical generalizations using the studies theoretical framework to help establish logic that could apply the findings in other situations (Yin, 2015). A list of propositions that informed the design of this study can be found in Table 5. The propositions in Table 5 informed my decisions on case selection, bounding of cases, as well as identification of potential data sources to answer my research

question. The collective tech career journeys including educational background, job search strategies, career history, and underlying motivations comprise the bulk of each case.

Table 5. Theoretical Propositions Informing Case Study Design

	Theoretical Propositions	Reference
a)	**Career related decisions are intentional; but do not always align with desired outcomes**	(Driver, 1982; 1985)
b)	**Personal values guide career decisions for some Black women**	(Brousseau, 1990; Driver, 1985)
c)	**Black women make career decisions based on a variety of influences (e.g., community, family, personal)**	(Vogt, 2008)
d)	**Black women have motivating interest not necessarily shared by organizations for which they work**	(Driver, 1982)
e)	**Black women will offset negative workplace experiences and unsatisfactory work roles by engaging in tangential activities outside of work (e.g., community building, non-profit work, entrepreneurship)**	(Driver, 1982; Vogt, 2008)
f)	**Black women in engineering are aware (either sub-consciously or consciously) of gender and racial bias they may face upon entering the workforce**	(Gurin & Epps, 1975)
g)	**Repeated barriers to advancement, workplace challenges, and increased stereotype threat due to hypervisibility and lack of role models contribute to burnout and Black women's decisions to leave**	(Crenshaw, 1990; Gurin & Epps, 1975; McArdle et al., 2007; Morton & Parsons, 2018; Rincon & Yates, 2018; M. Ross et al., 2017)
h)	**Work experiences, including barriers and opportunities for advancement, differ in tech depending on organizational context (e.g., smaller tech start-ups, tech entrepreneurship, established tech corporations)**	(Ebrahim & Singh, 2017)

3.3.1 Multiple Case Study Design

The consistent and unwavering status of Black women in engineering across multiple STEM industries, most notably technology, makes the use of a multiple case study appropriate. Multiple cases can provide insight on conditions under which a specific finding (e.g., career concept) may be enacted (Chmillar, 2012). Additionally, multiple cases allow for the study of Black women engineers' career orientations in varied contexts. Scoping the context and bounding the case are important as the ability to study the context and describe the case to the full extent that it is relevant has potential to strengthen the validity of the findings (Yin, 2012, 2015). I examined career concepts of Black women working as engineers in tech. The fast-paced nature of the technology industry highlights several access-related considerations and differences (e.g., job security, competitiveness, prestige, skill level, advancement opportunity) of working in a tech start-up versus an established tech company. The number of considerations, or variables of interest, are also why the number of data points, or cases, is likely to be small. The replication of findings across cases builds confidence to permit analytical generalization (Yin, 2015). Should data analysis confirm replication of findings across cases it will extend theory across the differing contexts (Chmillar, 2012).

3.3.2 Case Selection / Unit of Analysis/ Unit of Observation

My research design included ten cases to capture the perspectives of Black women engineers who entered tech from traditional (e.g., STEM education) and non-traditional (e.g., non-STEM or informal education) backgrounds. I selected cases using literal replication and theoretical sampling. Each case consisted of individual persons selected through purposive sampling to portray maximum variation in experiences of Black women engineers in tech. Purposive sampling enhances the richness, validity, and depth of information for each case (Bhatta, 2018; Chmillar, 2012; Eisenhardt, 1989; Harrison et al., 2017; Mills, Durepos, & Wiebe, 2010a; Tsang, 2013; Yin, 2012). The case boundaries were based on Black women's formal entry into the technology workforce, irrespective of their career outcomes. For example, some participants first full-time jobs in tech were in the context of a tech start-up. In Ashley's case she was the founder of her own tech start-up; however, other participants like Tonya, Tiara and Yvonne began their tech careers working at small tech start-ups. The remaining six cases in my study feature the career concepts of Black women engineers who began their professional tech journey working at more established tech companies (e.g., corporate). Among the participants who began working for tech corporations there is variation in their educational background. Where Hannah and Jocelyn have graduate degrees in engineering, Yasmine, Jocelyn, and Unicorn Magic have graduate degrees in computing fields and Candace is self-taught. In Table 6, I provide a high-level overview of some of the individual level differences in the 10 cases I analyzed for this study.

Table 6. Overview of Participants Selected for Multiple Case Analysis

ID	Entry to Tech	Undergrad Degree	Grad Degree	Relevant Industry Role(s) to Date
Ashley	Start-Up	STEM - engineering	M.S. aerospace engineering	Founder
Tonya	Start-Up	STEM- engineering	MS/PhD Electrical Engineering	Working Professional
Hannah	Corporate	STEM-engineering	M.S. Software engineering	Working Professional
Yasmine	Corporate	Non-STEM	M.S. Information Systems	Working Professional
Tiara	Start-Up	Non-STEM	n/a	Working Professional
Yvonne	Start-Up	n/a	n/a	Working Professional
Candace	Corporate	n/a	n/a	Working Professional/ Founder
Jocelyn	Corporate	STEM - computing	M.S. engineering design	Working Professional/Founder
Unicorn Magic	Corporate	STEM - computing	M.I.S. project management	Working Professional
Yana	Corporate	STEM – computing	M.S. Information Systems	Working Professional

I discuss my findings in terms of the themes and concepts that emerged across individuals' technical career journey. The career journey—including job titles, tenure, reflections, aspirations, and decisions of everyone—was the unit of analysis for each case. Regarding the career journey, I emphasize the industry and/or role immediately preceding their full-time entry into the tech workforce until their most current position (as of Fall 2020) if still in tech or their last known destination if they have left.

In total, I used a sample size of ten Black women engineers in the tech industry to describe varied career patterns and values defining their career concept and influencing their participation once in tech. A systematic review on the sample sizes used for qualitative dissertation work showed that case studies ranged from 1 to 36 cases, where analysis of the sixth data point was the average for data saturation (Mason, 2010). The use of existing data and social media artifacts to conduct this work resulted in an abundance of data for each potential case. However, between seeking approval from Black women to consent in having their public information analyzed for the study, the need for maximum variation, and in the interest of time, I elected just 10 cases to analyze and cross-examine to answer the research questions. In the following sections, I go into detail about the processes used to identify and select a secondary data set to conduct this multiple case study.

3.3.3 Institutional Review Board

Virginia Tech human subjects research approval, evidenced by an institutional review board (IRB) research protocol #19-1141, was obtained before any potential participants were contacted to ask for consent to analyze their existing and user generated data for this study. Additionally, participant feedback was contingent on the findings from template analysis and resulted in primary data gathering from human subjects. The protocol approval covers the entire study. I have included the electronic message prompts soliciting participant consent, see Appendix A; a copy of the consent form for using existing data, see Appendix B. I also include a copy of the electronic message prompts to solicit member checking, see Appendix C and the consent form for participation in member checking, see Appendix D.

3.4 Sourcing Secondary Data Using Social Media Artifacts

A significant portion of data collection involved preliminary work to identify potential sources and types of data to answer the research questions. In my preliminary work, I identified a cache of existing written, audio, and video material on the topic of Black women discussing their jobs and career related experiences while working in the tech industry. I analyzed this secondary and user-generated data as well as contextual materials found on the internet. A phenomenon of interest (e.g., career concept) can span a multitude of conditions extending over time, which often results in many variables of interest that may be essential to understanding the case (Yin, 2012). The large array of variables is precisely why the

data collection process typically involves multiple sources of data and types, and why the collection procedure (e.g., case study protocol, chain of evidence, triangulation, and rival explanations) is so important. The preliminary work included a three-month evaluation of internet-based sources including open forum contributions, online interviews, curated list, resumes, personal blogs, video logs (vlogs), podcast segments, public speaking engagements, company worker profiles, press releases, and social and professional media profiles pertaining to WOC discussing their career experiences in the technology industry.

Though less common in engineering education than some other fields, data collection using internet-based research is a well-established method in fields of psychology and behavioral sciences dating back to the early 90's (Reips, 2012). There are four main types of classifications when using the internet for data collection: (1) internet-based surveys and interviews, (2) nonreactive internet-based methods, (3) internet-based tests, and (4) internet-based experiments. My study utilizes nonreactive internet-based methods and data mining to identify and collect data to answer my research question. One of the specific strengths of using nonreactive internet-based data collection methods is the allowance of nonmanipulative events to be studied as they happen in their natural behavior on the internet (e.g., chatting, timing of events, topics discussed) (Reips, 2012). These nonmanipulative events facilitate the examination of social trends and patterns that can highlight factors, content, and issues germane to specific groups of people (Reips, 2012). Specifically, social websites (e.g., blogs, interactive pages with comment sections) provide a valuable source for social behavioral research based in nonreactive data collection as it gives insight into economic and major trends that represent values, desires, and interests of the dominant user demographic participating on that site (Reips, 2012).

3.4.1 Utility of Secondary Data for Case Study Research

The increased popularity and growing discourse on part of Black women in tech voicing their experiences online, and the advances in archiving and computing of qualitative data, made nonreactive internet-based data collection a viable and rich source of existing data for this study. Using publicly available secondary and existing data, this study focuses on generating substantive insights on the career orientations and associated patterns of Black women engineers in tech. As Hanson (2012) suggests, it is the selection of secondary data and analysis as the focal point that facilitates the study of trends and patterns, or gaps in analysis, of research undertaken collectively on a topic (Hanson, 2012). The unwavering changes in the status of Black women engineers in tech combined with the sheer volume, accessibility, and specificity of the content shared publicly online make using secondary data a timely and ideal source of data collection to answer my research questions.

When using secondary data as the basis for case study analysis, both the theoretical and practical definition of the case are important in assessing validity of the study and the findings regarding trends about the phenomenon of interest (Hanson, 2012). Therefore, the ability to speak to the comprehensiveness and selection of the data—including which search engines and search terms were used, the span of time covered in collecting the secondary data, and so forth—is critical to undertaking case study analysis that utilizes secondary data. Accordingly, I outline the iterative process used to identify sources of data with enough content and detail to potentially answer my research questions.

3.4.2 Identifying Sources of Secondary Data

Due to the overwhelming amount of existing data concerning Black women in tech, I restricted my search for secondary data by exclusively using the Google search engine. I used a manual form of web crawling—iteratively searching, identifying, and downloading web pages with relevant content (Thelwall, 2001)—to build the secondary data set informing this study. While web crawlers are computer programs that automate the process for mega data processing, the specific needs of my study, inclusion criteria, small sample size, and context of interest made manual web crawling a more feasible option. In Figure 2, I have outlined the step-by-step iterative process used to search and retrieve content for the secondary dataset informing this study.

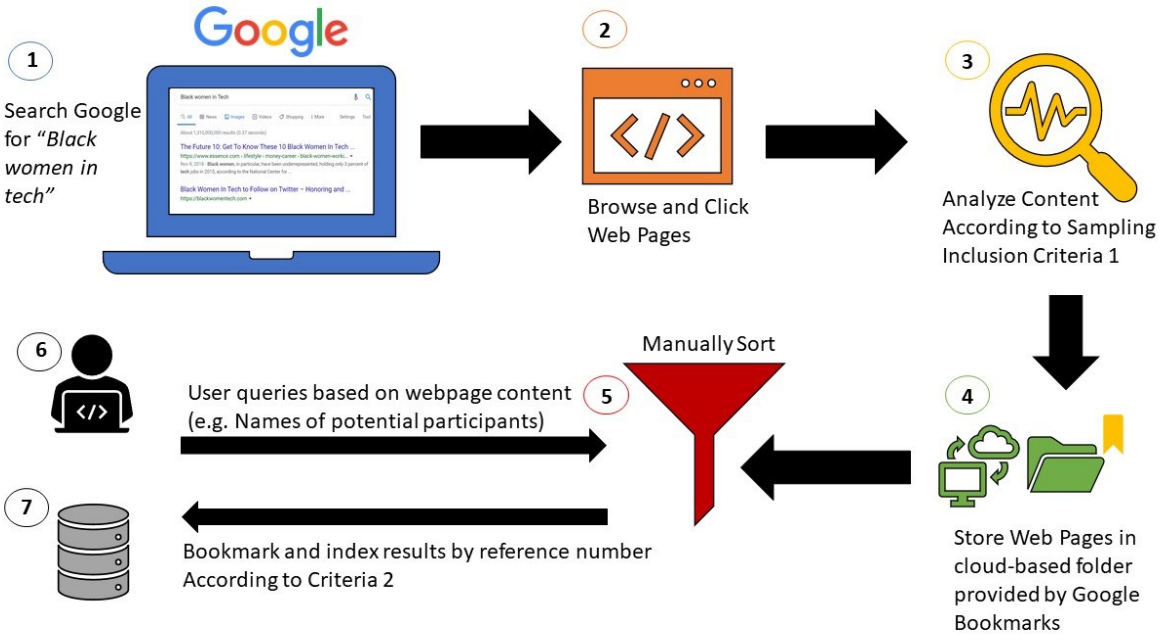


Figure 2. Step-by-step Search and Indexing Process to Identify and Collect Secondary Data Set

I followed the steps in Figure 2 iteratively to generate an index of webpages and names to identify potential data between May - July 2018. I will briefly describe the steps taken to build the secondary data set:

Using a Google Browser, I entered the phrase *'Black women in tech'* to begin my search query. I only considered results from the first three pages, paying more attention to the top 10 results located on the first page. I then reviewed and selected top results based on keywords in the webpage titles returned from the search. For example, a curated list of "*Top 100+ Black women in tech to Follow on Social Media"* was a top result that linked to a webpage whose sole focus was to publish an annual list of Black women in tech on Twitter since 2016. Aside from such curated lists, the bulk of the searches for Black women often returned results featuring WOC and POC broadly as well as multiple nationalities.

For each webpage of interest, I analyzed content based on whether the person fit the requirements for Criteria 1: (1) publicly recognized as a Black woman in tech; (2) had a degree in an engineering or STEM discipline -OR- training/certification in a closely related field and worked with an engineering title (e.g., data engineer) or in an engineering-related capacity (e.g., coding boot camp certification and working as a front-end developer etc.); and (3) had at least 1 full-time experience within the technology industry, previously or currently. Webpages that contained data meeting criteria 1 were bookmarked for storage in a cloud-based Google folder entitled "Black women Engineers in tech". Within the cloud-based folder, webpages were manually sorted and ranked. I created labels and notes for each webpage to facilitate search and find of information for later data retrieval.

Beginning with the most relevant ranked webpages, I began a new search query in Google entering the names of specific individuals referenced in webpages. I then proceeded to browse and click on top results found on the first pages returned to assess whether a new query was needed using more keywords. I analyzed results for a critical mass of individual tech career content to determine if the individual should be indexed for further consideration. Criteria 2, or the inclusion considerations for the webpage content, included: (1) education and training; (2) occupational history; (3) openly discussed career specific content to help answer my overarching research question; (4) experiences (early career, leaving, switching companies); (5) discussion of goals, motivations and or passions, aspirations for life broadly or career specifically; (6) mantras, career advice they took, or give; and (7) sources of influence (i.e. mentors, impactful events, etc.) While not all 7 criteria were required for inclusion, the first three criteria: occupational history, education and training, and open discussion of career specific content were mandatory for inclusion as they provide a common baseline of content with which to cross-compare cases and were contextually significant to understand participants career experiences and trajectories. For some women, their educational background and employment history were only accessible through the data they

shared via their private social media profiles (i.e., LinkedIn); these women were excluded due to lack of publicly available pertinent information.

In addition to webpages with curated lists of Black women in tech, I also experienced pop-ups offering email subscriptions upon entering certain websites. I took advantage of some of the subscription offers. An example of a subscription that resulted in a few additional matches for my study is POCIT (people of color in tech), an online newsletter whose mission is to share testimonials on non-traditional pathways to tech or unique persistence stories for POC in tech.

In total, I reviewed over 500 individuals that identified as WOC and shared aspects of their career experiences relevant to my research questions on the web. Criteria 2 allowed me to identify a subset of Black women in tech (n = 42) with enough publicly available secondary and user-generated data about their career journey to potentially include in my study. In the next section, I will discuss how this data was selected and indexed.

3.4.3 Selecting and Indexing Secondary Data

The secondary and user-generated data I encountered existed in multiple formats (e.g., written, audio and video files). In Figure 3, I provide a visualization of the data scraping process—steps taken from my indexed webpages to collect data via downloads from the web.

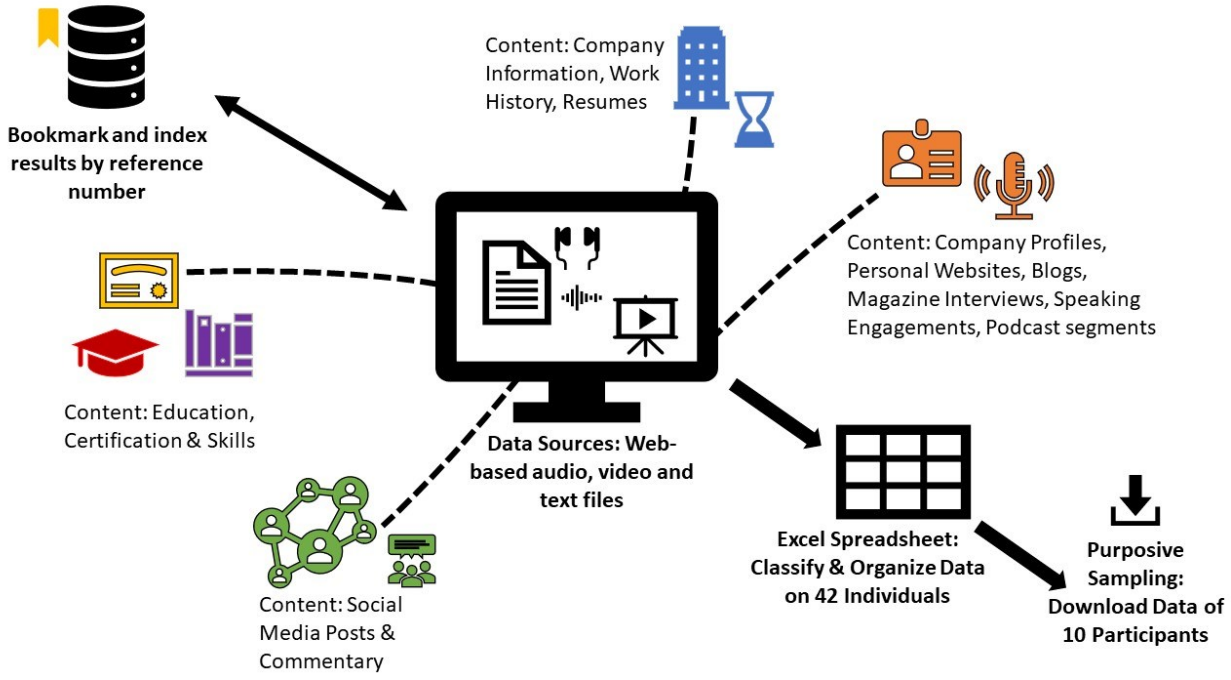


Figure 3.Overview of the Sources, Formats and Types of Data Curated for Secondary Data Set

Briefly, I describe the data sources indexed for the 42 protentional participants that fit the requirements for Criteria 1 and 2. The data sources came in a variety of formats including audio, visual, and written text. Secondary data existed as interviews, company profiles, and websites. User-generated data existed in the form of resumes, personal websites or blogs, YouTube channels and vlogs, public social media profiles (e.g., LinkedIn, Twitter), and video footage of invited panel discussions and speaking engagements.

I created an excel spreadsheet to list, classify, and organize the secondary data set. The rows of the excel spreadsheet correspond to the index number in the Google cloud-based folder and columns contain the names, current job title, education, current level of engagement in tech (e.g., executive, operational), current company name, ecosystem participation (e.g., tech giant, start-up, entrepreneurial, outreach), social media handle, overview of career journey content, data sources and formats that are bookmarked in the Google cloud-based folder. I also included a column for quick notes to document unique facts or circumstances of everyone. Next, I describe the process of building the 10 cases that were analyzed for this study.

3.4.4. Building the Cases

The secondary data set represented 42 potential Black women with a variety of career patterns and outcomes to and through tech. After submitting the potential data for IRB approval, I reached out to all 42 women to seek consent to use their data in the study. Of the 42 potential participants 15 consented to having their data analyzed in the study. Based on maximum variation, I selected 10 participants to include in the study. Individual persons and identifying information like company names will be protected by using pseudonyms. Upon consenting to the study, each participant was offered the opportunity to select a pseudonym for their case. Of the 10 participants, only three had preferences for a pseudonym. They were Candance, Unicorn Magic, and an additional participant who emphasized that she would be fine with any pseudonym that began with the letter J (I chose the name Jocelyn). An overview of the final data set is summarized in Table 7. This table is an extension of the information shown in Table 6 and details the various data sources and types that were used to construct the 10 cases on Black women's engineering career experiences in tech. This multiple case study was informed by over 60 different data sources across 10 cases with at least 4 sources per case for analysis.

Table 7. Overview of Data Set for 10 Cases

ID	Entry to Tech Industry	Undergrad Degree	Grad Degree	Relevant Industry Role(s) to Date	Data Source(s) and Type(s)	
Ashley	Start-Up	STEM	No	Entrepreneur	Interview (Forbes) Company Site Social Media (Instagram)	Interview (Entrepreneur) Interview (YouTube)
Hannah	Corporate	STEM	Yes	Working Professional	Company Site Interview (Tech Site) Interview (News)	Social Media (LinkedIn) Speaker Profile Blog
Tonya	Corporate	STEM	Yes	Working Professional/Inventor	Interview (Tech Site) Social Media (LinkedIn)	Personal Webpage/Blog Podcast (Tech Company) Interview (Tech Site – Gender)
Yasmine	Corporate	Non-STEM	Yes	Working Professional	Social Media (LinkedIn) Electronic Information Hub (personal profile)	Personal Website/Blog Speaker Profiles/Engagement
Yvonne	Start-Up	n/a	n/a	Working Professional	Company Blog Social Media (Twitter)	Personal Blog (Medium) Interview (Podcast -That's my Jam Stack)
Joceyln	Corporate	STEM	Yes	Working Professional/Entrepreneur	Company Site Interview (Medium)	Interview (Forbes) Social Media (Company Facebook)
Unicorn Magic	Corporate	STEM	Yes	Working Professional/Entrepreneur	Company Site Personal Webpage YouTube Channel	Interview (Tech Site) Podcast (Interview) Interview (Electronic Magazine)
Yana	Corporate	STEM		Working Professional	Company Profile Social Media (LinkedIn) Tech Site (profile)	Speaker Profile/Engagement Blog
Tiara	Start-Up	Non-STEM	No	Working Professional	Blog Company Profile Social Media (LinkedIn)	Social Media (Twitter) Interview (YouTube Channel)
Candace	Corporate	STEM	No	Working Professional/ Entrepreneur	Speaking Engagement (YouTube) Company Site	Interview (Medium) Tech Panel Speaker (Conference Video)

To help convey the variety of data included in the data set, I have listed the 28 unique types of data sources that were used to construct the career journeys for the 10 cases in Table 8. The information in Table 8 merely represents the variety of online sources that I used to construct the cases and do not reflect the raw number of data points used across the 10 participants in my study. For example, there are 5 different electronic- or E-magazines included in which participants had been interviewed; however, multiple participants had been interviewed by the same E-magazine (e.g., 2 participants were interviewed by Forbes).

Table 8. Existing Data Sources and Quantity Used to Construct Cases

Data Source Variety	No.
Educational Institution	2
News	3
Electronic (E-) Magazine	5
Personal Website	5
Company Website	5
Podcast	2
Social Media	4
Blog	2
Networking/Speaker Profiles	3
Race, Gender, Tech Sites	6

In the following sections I discuss the plan for data analysis including the manipulation, sorting, and organization process for this large volume of secondary data.

3.5 Data Analysis

A distinct feature of case study research is that it facilitates the use of multiple data sources to aid the researchers in focusing on a bounded or otherwise limited situation of interest (Bhatta, 2018; Chmillar, 2012; Eisenhardt, 1989; Souza et al., 2017; Tsang, 2013; Yin, 2012). An oft cited strength of this approach is the richness that arises from the variety of data (e.g., interviews, images, documents, sounds, etc.) (Bhatta, 2018; Chmillar, 2012; Eisenhardt, 1989; Tsang, 2013; Yin, 2012). However, the vast amount of potential data can also pose challenges in terms of the volume of collected data, which can be difficult for researchers to manage during analysis. Managing case study data raises concerns regarding quantity of the data, the organization of the various types and formats, as well as the manipulation needed for analysis (Creswell, 2013; Denzin & Lincoln, 2011; Pistrang & Barker, 2012; Stake, 2008). Secondary data analysis further complicated this approach. In working with secondary data, the development and process of manipulation is fundamental and includes editing, sorting, categorization, organization, and retrieving the data (Mills, Durepos, & Wiebe, 2010b). These concerns can cause the researcher to become overwhelmed and lose sight of the research questions, which is why it is important to specifically outline a plan for data manipulation in the methodology (Sarah Crichton, 2012; Reips, 2012). This section will primarily focus on the plan for the data analysis, including the organization, and manipulation of the various types and formats (e.g., written, audio, video) of data collected to answer the research questions in this study.

I used **Microsoft OneNote** software program to organize, manage, and analyze the text, image, audio, and video data. The OneNote software is similar in capability to other Computer-Assisted Qualitative Data Analysis Software (CAQDAS) like Dedoose and NVivo. The exception is that OneNote is touted to be more user friendly when compared to other CAQDAS options with a low learning curve (Fernandes & Barbeiro, 2015). Microsoft OneNote was used for the coding, searching and retrieval of data as well as memos and annotations of the data for reporting and analysis purposes. The OneNote software has the capability to password-protect, search, and navigate across sections, notebooks, and pages. Additionally, I elected to use OneNote as it allowed for analysis of data in its original format**.** Though researchers typically conduct data analysis by first transcribing the data, there are known issues to this step. Foremost, transcribing can be a cumbersome process and cost in terms of time and money (Sarah Crichton, 2012; Susan Crichton & Childs, 2016). Additionally, transcribing reduces the data from a rich three-dimensional state to a two-dimensional format. An alternative to transcribing data that mitigates these shortcomings is maintaining the original three-dimensional format (Sarah Crichton, 2012; Susan Crichton & Childs, 2016). Maintaining the original format of audio and or video files during analysis instead of transcribing and then analyzing has the potential to overcome challenges of managing

large volumes of data, conserving time as well as preserving the potential richness of the various types of data (Susan Crichton & Childs, 2016).

3.5.1 Data Manipulation, Sorting & Organizing

Given the use of social media artifacts and existing data for this study, OneNote enabled me to embed, sort, and analyze a variety of digital content (e.g., audio files, online videos, and text files) related to each participant's career journey. non-text data were embedded into the software and analyzed in their original format. I elected to review the data in its original format as a way for me to be present in the data (G. James, 2017). As Sarah Crichton (2012) points out, working with data in its original format enhances the development of theory that is accurate, well supported, tested, and interesting. Analysis of data in its original format also provides a more objective view of the data, revealing additional details which can enhance theory that emerges through the sorting and analysis process (Sarah Crichton, 2012). Unlike the transcribed interviews that were available for analysis from existing sources, where emphasis of participants is indicated with exclamation points or text written in all capital letters, my review of video and audio files from data in the original format allowed me to hear and see first-hand the changes in tone, volume and expressions that came with participants retelling of their career experiences. The ability of OneNote to embed and play all file formats as well as clip all or part of any webpage within the notebook in addition to the other qualitative analysis functions made it superior to the other CAQDAS for this study, where I used existing data alongside social media artifacts as a secondary data set.

Data Sorting. In OneNote cases were separated into individual sections within the same notebook. Each section consisted of two pages: the uncleaned data was put into chronological career timelines in a password protected section of the notebook, and a second page of notes was within each section to summarize high level case findings, themes and contained annotated notes and memos. For the career timelines, I organized the data sources for each case chronologically according to order of life events (e.g., education, first internship, first tech job, etc.). The audio and video data were placed alongside relevant text-based data. I compiled all text interviews, relevant text from personal webpages, profile pieces, and resumes and placed them in order for each participant. Each event on the timeline was then annotated with thin description to include the date the data were recorded, with whom, and for what purpose. Briefly, thin description is described as un-interpreted data and the systematic documentation of who, what, where, and when of the action (S. D. Brooks, 2017). For data sources that contained content spanning multiple life events, segments of video clips were placed at appropriate timepoints in the timeline. For example, a video of a participant recounting their earliest STEM interest and then later describing their undergraduate engineering experience was be spliced into two segments and the

respective segments were then placed chronologically on the timeline. These timelines served as graphic elicitations of the participants career journey summarizing their past, present as well as their projections and expectations for their future lives. The timelines contained biographical data and experiences important to participants time in the tech workforce. Additionally, events and/or societal impacts mentioned as significant sources of influence regarding their tech experience were also included on the timelines.

Data in Written Format. Most of the sources existed in written text displayed on webpages, or as transcripts from past interviews. As the data are secondary or user-generated there were extraneous data contained across the sources that were not particularly insightful to my research questions. For example, Forbes Magazine interviewed several Black women in tech and asked a range of questions some of which resulted in data relevant to this study (e.g., How did you get started in STEM?) and some that yielded responses that were less relevant (e.g., What is something that most people do not know about you?). Thus, for the data existing in written format, I used selective sampling from text sources (Brinkmann & Kvale, 2015) and kept only the relevant parts of interviews. I looked across each written source individually (e.g., interview transcripts, company profile bios, personal website – About Me sections) to identify text to include for each case. The thin descriptions were used to differentiate data from different webpages. For example, the nature of the interview, the entity or person conducting the interview and for what purpose as well as the date and time of the interview were summarized adjacent to the actual text to be analyzed.

Data in Audio and Visual Format. For the audio and visual (e.g., videos and podcasts) data, I initially listened to the full data source in its entirety. For videos or podcasts where multiple subjects were speaking, for instance on a panel, I would make note of the time segments in which the participant of interest was speaking, or I would note the general time segments when the major topics changed (e.g., discussion of early childhood STEM interest, first tech job experience). I then embedded the portions of the audio/video URL directly into participants respective OneNote section for instant playback during analysis and included annotated notes alongside key timestamps. For images or unique webpage layouts I clipped all or part of images into the notebook page. The technological advancements in the OneNote software allowed me to manage the digital content directly, enabling direct manipulation and analysis of audio and visual segments of interest. Working directly with digital data is not a new method; it was introduced to qualitative research in 2005 and has since grown (Susan Crichton & Childs, 2016). The shift in practice can improve both the quality of the study and aid in a richer presentation of the findings.

The individual notebook sections for each case provided a detailed overview of participants career journeys emphasizing the events germane to participants experience in the tech industry. Creating timelines and using OneNote to embed audio and video data for instant replay allowed me to keep the images and/or voice of the participants intact for as long as possible. The use of selective clipping and coding of secondary data allowed me to analyze data specific to the sample participant as well as hear and see gestures, pauses and intonations usually noted descriptively during the transcription process (Susan Crichton & Childs, 2016).

3.5.2 Thematic Analysis

Once all the data for the ten participants was organized chronologically into timelines and dictated with thin description (e.g., descriptive details and context), I began analyzing each case. I used template analysis, a form of thematic analysis, to begin answering my overarching research question. Template analysis is essentially a hybrid form of analysis, first using a deductive theory driven coding system then proceeding to inductive coding of the data (J. Brooks et al., 2015; King, 2012; King & Brooks, 2016b; King & Brooks, 2017). By using template analysis in combination with Black feminist thought (BFT), my ultimate goal was to advance theoretical explanation of career concepts held in context, specifically illuminating the variety of career orientations that exist for Black women in tech (Bhatta, 2018; J. Brooks et al., 2015; Eisenhardt, 1989; King & Brooks, 2016b). For the first round of deductive codes, I used *a priori* codes from the CCF. Having selected my cases using replication logic, I first coded for theoretically based themes in the data. Once new themes began to emerge or juxtapose the CCF I began the transition to open or inductive coding, moving from the specific to a more general level of analysis. The OneNote software enabled me to create codes, referred to as tags in the software, where there was an option to select symbolic icons to accompany each code. I also typed memos for each case and then was able to search and compare codes and memos across sections and pages to identify shared themes and career patterns that indicated career concepts. During the cross-case analysis, the use of icons alongside each code made identification of related codes and patterns clearly visible in the data.

I employed Black Feminist Thought (BFT) as a lens to help ensure that the impact of identity, social class, and power structures was not lost when examining the interactions, influences, and experiences at multiple levels and across occupations of participants in their career experiences in the tech industry. A more detailed overview of the template analysis conducted in this study can be found in Table 9.

Table 9. Plan for Template Analysis of Individual Cases, adapted from King (2012).

Case by Case Analysis	
Deductive Coding	With career constructs theory in mind, I looked for themes, patterns, and values that I expected to find based on the four known career orientations. The focus of this round of coding was to map each of the cases into an existing career construct as closely as possible, noting deviations and differences from the CCF. Deductive coding occurred iteratively using a method of constant comparison for each case.
Inductive Coding	I then re-analyzed each case using inductive codes. Based on unique terms or themes derived from the words and/or experiences noted in the timelines, the inductive codes ascribe to details (e.g., job patterns, values) that either deviated from the CCF or were previously not captured by the CCF. The focus of this round of coding was to identify whether and how the patterns of Black women's career journeys differ from existing theoretical career constructs and record the extent to which they differ. Inductive coding occurred iteratively using a method of constant comparison for each case.
Cross Case Analysis Using and BFT	
Deductive Coding	Looked across cases that mapped similarly to the CCF to identify patterns and common themes in participants career experiences and outcomes. This will work to extend career constructs theory into new contexts where similar constructs are found across cases.
Inductive Coding	Looked across cases that deviate from CCF to see if there are similarities in how they deviate. Noting patterns in themes or categories of differentiation among participants career experiences and outcomes. The purpose of cross-case analysis using inductive coding is to determine if new or hybrid constructs emerge from the data for the sample under study.

To refine and clarify categories and concepts, I used memoing and annotations to capture comments, initial thoughts, or concerns on emerging concepts within the data. Memos linked to specific topics found in the data can be searched for across notebooks. Data analysis continued until findings reached a point of saturation, indicated by a level of detail and richness that typically occurs through an increasing number of study participants. Once each new observation provided evidence consistent with the CCF and or themes emergent in the data and no new themes are formed or changed the case-by-case analysis was considered complete.

Cross-case analysis. To describe the nuances in their non-traditional (e.g., non-linear) career patterns, I characterize the degree to which the women are value-led in their tech career decisions relative to one another. I also made determinations related to the extent of the career mobility relative to other cases. To do this, I classify the women into empirically derived career archetypes (Briscoe & Hall, 2006) based on their physical career patterns and evidence of psychological factors found in the data. I compared the physical patterns of mobility across participants and made determinations among high and low physical

mobility. I also analyzed changes in occupational roles and made determinations on psychological dimensions (e.g., adaptability and values).

3.5.3. Visual Portraiture

The study is concerned with documenting the ways that Black women in tech orient themselves toward a career across contexts, especially concerning points of access and how agency works for and through them. Because portraiture takes into consideration the perspectives, context, and social aspects of the people with whom the researcher is collaborating (S. D. Brooks, 2017) it has the potential to illustrate the reality of *what a career is* for Black women in tech and the stories embedded in their lived experiences. In this study portraiture is used as a form of documentation to illustrate the findings of template analysis as well as a form of inquiry for member checking to confirm the study findings. I elected to go beyond the standard interview, using visually based diagrams of study findings in-lieu of an interview protocol, to encourage thinking, generate new ways of interrogating, and understanding (Bagnoli, 2009). The inclusion of non-linguistic dimensions in research, may allow access to and representation of different levels of experience (Bagnoli, 2009). Visual methods are a helpful form of expression for people of all ages. The use of visual methods facilitates the investigation of an experience in that they can evoke memories and feelings otherwise not easily communicated enhancing empathic understanding (Bagnoli, 2009).

Portraiture methodology is distinguished from other forms of ethnographic research by its focus on the co-construction of symbolic meaning that is re-framed in terms of interpretation in the portrait (S. D. Brooks, 2017). The researcher (the artist) interprets the subject of the portrait and searches for meaning and coherence in the data. The researcher then represents the interpretation in the construction of a portrait that intentionally employs aesthetic aspects (S. D. Brooks, 2017). The participant makes sense of the subject by actively interpreting the portrait, and in the re-interpretation, portraits are re-created (S. D. Brooks, 2017; Lawrence-Lightfoot, 2005; Waterhouse, 2007). I used visual methods to facilitate member checking, to enhance participants' reflexivity and to gather a holistic picture of the career constructs under investigation and consider different experiences and points of access into tech. Based on the major themes that emerged from the different career conceptualizations in the study, and how they deviated from the CCF or were replicated across contexts, I constructed visual portraits to help interpret and member check the findings.

Using visual portraits, I was able to illustrate the various career constructs exiting among the Black women engineers in this study. Illustrations make use of the variety of dimensions including the visual and the sensory which cannot always be expressed in words (Bagnoli, 2009). Portraiture methodology aims to capture lived experiences through a blend of art, science, and research (S. D.

Brooks, 2017; Bagnoli, 2009). According to S. D. Brooks (2017), portraiture is the combination of empirical description and aesthetic expression. The researcher creates a portrait to articulate their understanding of a complex combination of analyses, interviews, observations, and dialogues with the data (Bagnoli, 2009; S. D. Brooks, 2017; Waterhouse, 2007). With theory in mind the researcher interprets the data and then intentionally employs aesthetic aspects to represent the interpretation (S. D. Brooks, 2017). The portrait serves as a valid, yet partial construction of a lived experience in context and is a product of a unique perspective on a unique set of experiences (Waterhouse, 2007). An example of the visuals used for member checking can be seen in Figure 4, the portraits resemble diagrams that included some imagery and listed the major themes that captured the participants career stories.

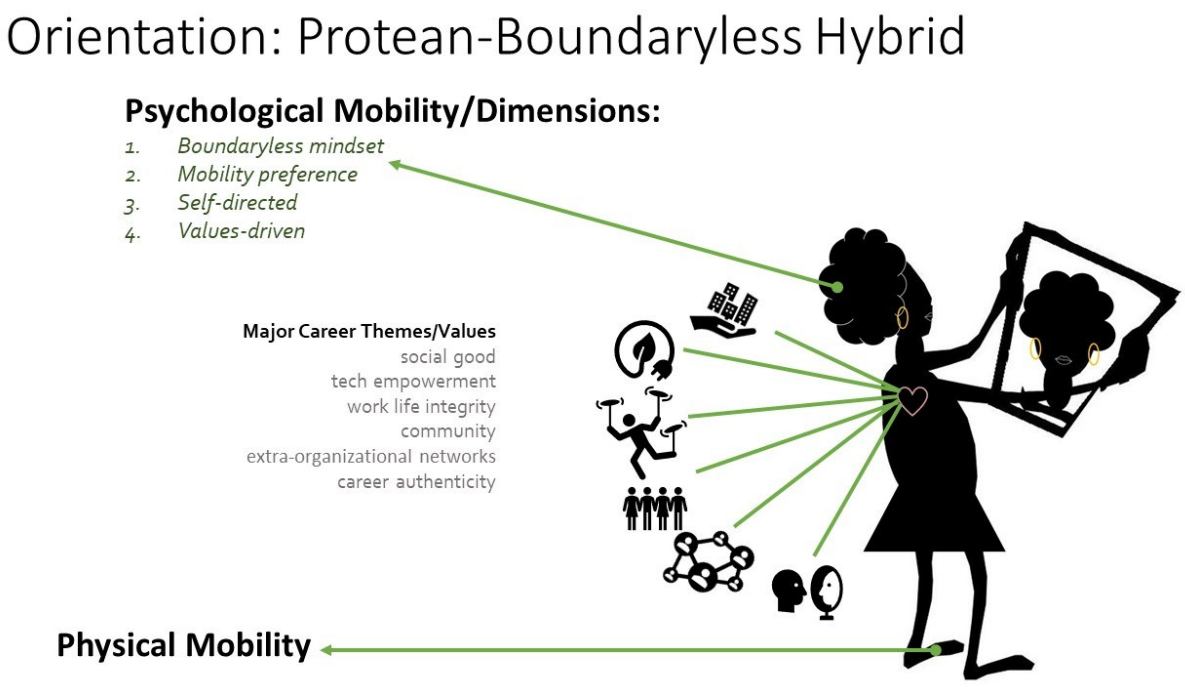


Figure 4. Visual Portraits of Study Findings for Member Checking

For the study participants, the visual portraits were augmented to reflect the findings of their individual case analysis. The visuals were used as point of reference to highlight the major findings of the study and point out to participants ways in which their data differed from other women in the sample. Having the visuals as a point of reference, other than simply text or verbal explanation, gave the participants something to reflect on. Each session had a moment of silence as the participant looked at the visual after I explained what each element represented. The symbols for the themes were explained and then pending the participants' questions or comments the characterization of their career and anticipated challenges were read aloud to them. Their initial reactions were captured by the researcher in the form of note taking and asking follow-up questions to their reactions. A similar visual was used for member

checking with other Black women in Tech, but the difference is that the same visual was used in each of the five member checks with women outside of the study. Instead of individual career orientations, the visuals for community member checking represented the shared themes across all 10 participants. Women outside of the study sample were asked which parts if any of the findings resonated with their experiences, and after answering they were asked if any other parts seemed to fit the experiences of another Black woman they may have known.

Of the six participants that participated in the member checking three of their case data mapped to the same hybrid orientation, i.e., Protean Career Architect. Therefore, there were only four unique visuals used during the member checking round with participants: (1) the Wanderer for Yana, (2) Transformist for Hannah, (3) Solid Citizen for Tonya and the (4) Protein Career Architect for Jocelyn, Candace, and Unicorn Magic (see Appendix E-H). A more general visual was used for the member checking round with the five Black women outside of the study (see Appendix I).

3.6 Measures of Quality

To ensure quality of the study from data collection to analysis and interpretation I used a combination of reliability and validity measures when curating the data set. Additionally, I used both negative cases and two forms of member checking to confirm and validate the findings and my interpretations with participants and other subjects that identify as Black women working in tech. In the sections below I describe in detail the various processes used to increase the quality of the study.

3.6.1 Reliability

To establish reliability in the procurement of the existing data set, I began reading curated lists of Black women in tech. I only considered such lists as reliable sources if the following criteria were disclosed: (1) mission behind the creation of the list was clearly articulated; (2) inclusion criteria for making it onto the list were displayed; and (3) whether individuals on the list were aware of their listing. If all these criteria for the data sources were met, then I explored the individuals listed to determine if they met the inclusion criteria detailed in section 3.4.2 to be considered further for this study.

Having sourced an abundance of data on both personal and professional aspects of participants lives, certain personal details from each case were intentionally omitted. There were dual concerns that influenced which information I emphasized in the re-construction of participants' narratives. The first concern was their identity, and details of their personal lives were omitted to protect the anonymity of the participants. Given the way participants were sampled and the use of existing and publicly available data, certain facets about their lives (e.g.,, pivotal life events – death; hardships) make them readily identifiable. (Note: The omission of these details from the final stories does not necessitate that these events were not

documented and analyzed in each participant's stories, just that they were not the anchor from which participant success was painted.) The second concern was to not reinforce negative stereotypes about participant career success from a deficit view of an entire community (Baldridge, 2017). Like many studies on women, the topic of family and children arose; and like many studies on first-generation and minority engineers, the topic of socio-economic status and inaccessible STEM education in K-12 also were obstacles within some participants' stories. However, none of these events or circumstances individually or collectively accounted for participants success and not all the participants shared in these experiences.

3.6.2 Validity

To reduce misinterpretation and provide validity to this study, I incorporated redundancy of data gathering (i.e., multiple sources of data). According to Stake (2008), the use of multiple cases is in itself another measure of quality. The use of multiple cases will illustrate how a phenomenon occurs under the circumstances of several examples and establishes trustworthiness (Stake, 2008). The study of a variety of career experiences across contexts in tech will be used to visually depict how the meaning of a career is constructed and how that construction occurs under different circumstances (e.g., STEM and non-STEM educational backgrounds, formal versus informal training processes). By including multiple perceptions, or triangulation of collected data, to understand what it means to enact a career in tech, I can clarify meaning, and verify the repeatability of an observation Stake (2008). For example, to better understand the transitory career construct, I am including Black women engineers whose career journey began with entrepreneurship (e.g., developing a successful application) as well as those who ventured into entrepreneurship after multiple years of working in the corporate sector.

3.6.3 Negative Cases

The inductive coding portion of template analysis combined with the theoretical sampling will allow a review of negative cases. Negative case analysis is a method of boosting qualitative methodology rigor and strengthening validity of qualitative study results (Tenzek, 2017). In the process of negative case analysis, the researcher analyses cases that do not support the theory (e.g., forms new or hybrid career constructions that encompass the negative case(s). Analytic induction and review of deviant cases offers an interpretation of the data that is inclusive and supported in the data. The researcher continues this process of collecting, interpreting, and analyzing data, with the goal of addressing all negative cases until no more discrepancies emerge in the data. The analysis is iterative and constantly compared against itself as new data are collected, analyzed, and work well to extend or develop theories (Tenzek, 2017).

3.6.4 Member Checking

Member checking occurred in two rounds. In the first round I sought feedback from the participants whose data were analyzed to construct the 10 cases. In the subsequent round of member checking, I sough feedback from subjects who represented Black women in the broader tech community. The first round of member checking served as an opportunity for feedback on the communicative validity of my interpretations and depictions about participants individual career constructions that emerged from the data. The second round of member checking served as a measure of pragmatic validity and transferability of the findings as I received feedback from respondents who represented Black women in tech broadly and not necessarily those working in an engineering or computing capacity.

3.6.4.1 Communicative Validity

This first round of member checking serves as form of communicative validity to make sure that through my interpretations and visual portraits I have captured the participants subjective reality (Walther et al., 2013). In the first round of member checking with study participants I solicited feedback on the high-level findings and themes from the study. I also sought feedback from participants regarding their empirically derived career archetypes adapted from Briscoe and Hall (2006). In total I obtained feedback from 6 out 10 of the participants on both high-level findings and individual career archetypes.

Feedback to High-level Themes

Overall, participants resonated with the study findings. In reacting to the study findings, the participants identified missing vicarious career experience not captured in the study. One of these missing experiences was about Black women in Tech that go into organizations as *"the only one"* yet, stay there, sometimes for decades, with intentions of championing change. They have bought into a vision of a paradigm shift that they hope to be a key part of. They referred to them as *"the ones that are in it for the long haul."* The other voice, participants called attention to, is the Black woman who *"decides to enter"* and or stay in an organization knowing that is not the best *"fit"* for her (e.g., interests, career development or wellbeing) out of loyalty, not to the organization, but to a specific individual *"who took a chance on me."* These Black women may be mentors or play a supervisory role, agnostic of who the individual is, some Black women sometimes stay too long. I provide a more in-depth discussion on these missing voices in chapter 5.

Participant Reactions to Career Archetypes

Based on the physical and psychological career dimensions expressed in each case, participants were rated high and low relative to on another, which resulted in the 10 women mapping into 5 of the 8 hybrid career archetypes proposed by Briscoe and Hall (2006). I then created career profiles based on a combination of empirically derived career challenges and the relationships between major themes that showed up in their respective cases. I presented these hybrid career archetypes to 6 out of 10 participants for feedback during member checking. Participants were asked whether their career outlook and experiences were reflected in the archetype their data matched into and to comment on any changes they would make. In chapter 4, I provide more discussion of the career archetypes and participant reactions to their individual hypothesized career challenges. While most participants felt the career, archetypes were accurate and helpful (e.g., in hindsight), some found the career archetypes to be more "aspirational" but not necessarily descriptive of career experiences had to-date.

3.6.4.2 Pragmatic Validity

For the second round of member checking, I solicited feedback from Black women in the tech community for pragmatic validation. Briefly, pragmatic validation aims to confirm whether the career concepts found in my data withstand exposure to the phenomenon being investigated (Walther et al., 2013). The second group of member checks occurred with another 5 Black women in tech to determine whether findings resonated with members of the broader community of Black women working in the tech industry. Member checking with the broader community of Black women also occurred through electronic means. Beginning with my own network as a researcher I solicited participation both online (e.g., via Instagram and LinkedIn) and through word of mouth. The final visual portraits summarizing the career concepts found in the data set were presented to 5 Black women in one-on-one meetings via video conferencing (e.g., Zoom platform). Overall, the second round of member checking supported the study findings. Black women in tech said that parts of their own experiences were reflected in the study findings and the parts that did not resonate with their personal experiences did hold true for other Black women in tech that they knew.

3.7 Limitations

This dissertation study is meant to sample the career orientations of a subset of Black women engineers in tech. The findings should serve as a baseline to verify differences in, as well as categorize the variety of existing career concepts held by Black women who exhibit a high degree of mobility in their careers. For this study career mobility is considered in both psychological dimensions (e.g., changes in industry, or subject matter expertise in technical niche areas) as well as physical dimensions (e.g., frequent changes in duration and tenure at a given company). Given that the phenomena of interest were

directly tied to career mobility this is not in and of itself problematic but does warrant acknowledgement and some discussion related to limitations of generalizability of case study findings. Therefore, the findings may not generalize well to the experiences or motivations of Black women engineers in tech who exhibit less career mobility. Support for this limitation was first illuminated during the member checking feedback. Members from both rounds of member checking alluded to, or outright referenced other types of Black woman in the tech industry whose entire careers were at just one company and pointed out ways that their career patterns and career conception was not readily reflected in the study findings. Therefore, Black women who work in tech but are less mobile may not be able to resonate with the study findings. I used member checking with a broader community of Black women in tech in-attempt to gauge the extent of missing voices from this study. In Chapter 5, I discuss more in detail about the missing voices of Black women engineers that were omitted from my sample. Furthermore, participants who stay at one company for the duration of their career, are less likely to openly discuss their holistic career experiences (e.g., challenges with promotion, misalignment of personal values and organizational mission) publicly on social media.

Given the data sources used (e.g., existing data and user generated social media artifacts), there was also a degree of visibility required for potential participants to even show up in the searches. To that extent there were limitations to the sampling frame, where participants who were not present or engaged in online platforms likely did not show up in my return search query to identify potential participants. Essentially, there is a potential bias of the study findings toward Black women who are "visible" in terms of having an online presence (e.g.,, social media profiles), especially those with a recognizable platform (e.g.,, Alumni features, Forbes interviews, etc.). As such, the findings of the study may not resonate with the career experiences of Black women in Tech who are less 'visible'. To that same point, given my web searches were limited to the top results within the first three web pages that were returned for the search query, and some participants names were found using curated list based on people in STEM who were trending on social media (e.g.,, Twitter), my participants represent visible Black women who were popular at the time of the search (e.g.,, summer 2018). Trending on social media refers to a "subject that experiences a surge in popularity on one or more social media platforms for a limited duration of time," (BigCommerce, 2021). Essentially, people or topics that are trending can be said to hold consumer interest, or be the "hot topic" of conversation, that many people are sharing their views on within the public (BigCommerce, 2021).

For my study, it is important to consider that, while the participants may represent a unique subset of Black women's career experiences that not every Black woman readily resonates with, their experiences have reached a particularly high level of popularity on the internet and likely possess a degree of vicarious career influence for the thousands of Black women who lack role models and representation

in their respective engineering careers. In summary, there is a potential bias in the findings toward a unique subset of Black women with careers in tech; however, given how they were sampled it is also likely that these women represent aspirational career trajectories and ambitions among a wider audience of WOC in STEM and for that reason amplifying the experiences of these cases is a noteworthy goal.

Similarly, the findings are limited in providing insights on the career conceptions of Black women who have left the engineering profession or tech industry entirely, particularly those who chose to exit early in their careers. Both theory and empirical evidence from this work support that some aspects of the psychological career dimensions (e.g. career motivations) important for participants persistence as Black women in tech are temporal (e.g. related to time) and hinge on a combination of self-development and experience that further promote self-awareness (Prince, 1979; Schein, 1990, 1996). This self-awareness not only aids participants in their consideration of possible career opportunities but also helps to direct their career decision-making to align with subjective career success and satisfaction (Goleman & Boyatzis, 2017). The experiences of the Black women who left engineering before this temporal period may not be well reflected in the findings. Having stated that, these findings should still prove useful for mobile Black women in tech at all career stages (e.g., early, middle, late) to either provide foresight, insight, or hindsight to career decisions and strategies that promote subjective career satisfaction.

According to Stake (2008), the selection of a case and the boundaries surrounding it make it impossible to tell the whole story of each case (e.g., person's career) and is an inherent limitation of case study research. The criteria for inclusion in cases as well as the criteria for limiting the data types and sources included in this study originated from a practical sense to accommodate feasibility of access and timeliness to complete the analysis in accordance with the dissertation schedule. For the procurement of the secondary data set, I relied exclusively on Google search engine. Additionally, the searches on individuals were not exhaustive; I only considered the top 10 links that appeared on the first page of results. Based on the cumulative feedback from member checking, I would argue that most Black women in tech will either resonate with being physically or psychologically mobile; however, the degree to which Black women exhibit high mobility in both career dimensions appears to be unique to the participants in this study. This study is therefore best limited to Black women in tech with a relatively high propensity for mobility and are actively engaged in online communities.

3.8 Summary

To summarize, I described a research design to explore: *How career concepts influence the participation of Black woman engineers in the technology workforce?* I used a multi-case study methodology to describe the variations in meaning and enactment of career by Black women engineers. This study supports both the extension of career concepts theory and validates other ways of doing

engineering to facilitate in broadening participation. This work is situated to disrupt the monolith that is our understanding of Black women engineers and fill literature gaps on the workforce experiences of underrepresented people in tech. I have outlined the process for identifying, sorting, and collecting the secondary data set to be used for answering the research questions. I have also described the plan for data analysis of each case and across cases to highlight the multiple perspectives and modern variations of career orientations. I discuss the plan used to interpret the findings from the analysis and the development of the visual portraits, which were used to facilitate member checking. In the next chapter I provide an in-depth analysis of the findings.

Chapter 4: Multi-Case Study Findings

4.0 Introduction

In chapter 4, I present the study findings as a result of the template analysis described in the previous chapter. To fully answer the overarching question, *how do the career concepts of Black women engineers influence their career mobility strategies in the tech workforce?* thematic codes were developed for both career motives as well as mobility strategies (e.g., approach to the job search) from each participant's career journey. Because their mobility is the phenomena of interest, the shifts, and changes in both their career motivation(s) and strategies provide insights to the variations across participants career experiences and outcomes. As such, I briefly provide an overview of the thematic codes that emerged related to career motivation and strategies, see Table 10. I used the codes for motivations and strategies to unpack how each participant enacted their career in tech—specifically as it relates to how they got started, the dominant pattern of their movement while in tech, and why they have remained (e.g., effectiveness of strategies in identifying career opportunities).

Table 10. Sub-themes for Career Motivation and Mobility Strategies Related to RQ1

Career Motivation	
Needs-based	Job security, stability
Value-based	Challenging work, social mission
Talent-based	Subject matter expertise, technical competence, innovation (e.g., opportunity and identification of new businesses, products, or services)
Mobility Strategies	
Necessity	job search based on quantity over quality. A numbers game to increase odds of a match, not much personalization per application or intentionality behind companies being applied to.
Networking	job search based on who you already know.
Intentional	job search based on values (value agnostic). Use personal values to establish criteria for job or organization; seeks alignment with organizational mission/vision, job role, environment etc.
Recruitment	visibility and expertise result in being solicited by talent acquisition managers, or headhunters looking for specialized skills

This chapter is organized into sections that correspond to the three guiding research questions, which are:

RQ1: How have Black women engineers entered the tech industry (e.g., where did they transition from, early career motivations, early job search strategy)? (section 4.1)

RQ2: What are Black women's values, and how are their career decisions and outcomes (e.g., job changes, promotions) influenced by those values? (section 4.2)

RQ3: Why do Black women engineers persist in the tech workforce? (section 4.3)

For each of the sections that correspond to the three research questions (4.1-4.3), I first provide a high-level answer to the question, provide descriptions of the major themes that emerged, and then use cascading narratives of participants experiences to highlight differences in theme expression among cases. In section 4.1, I provide an in-depth look at how each of my participants entered tech, grouping cases by similarities in the types of transitions where possible and delineating key differences about themes related to career motivation and job search strategies that are expressed differently across cases.

Note to the reader. Due to the high-profile nature of these Black women online and the public access to their platforms, I have intentionally obscured certain personal details (e.g., former employers, specific years of employment and names of start-up organizations and nonprofits) for their continued privacy.

4.1 Participant's entry into the tech industry

In this section, I describe findings to RQ1: **How have Black women engineers entered the tech industry?** The findings for RQ1 provide insights into three key components of entry, namely: (1) where did they transition from, (2) what were their early career motivations, and (3) what job search strategy was utilized to land their first job in tech. I then briefly define the type of transitions into tech before I use narrative style quotes to convey how participants entered tech. To compare participants 'entry' into the tech industry, I grouped their transitions into tech into three categories. I identify sub-themes related to motivations and strategy and use narratives of participants experiences within each transition group to illustrate diverse theme expression among participants. Together, the findings for RQ1 illustrate each participants STEM origin story and the relevant experiences that led them to enter careers in tech.

In reference to participants entry into tech, the transition captures their employment or status immediately before accepting their first fulltime role in the tech industry. The following three groups of transitions collectively describe where participants "entered" tech from:

Transition into tech from university – this transition described participants whose career experience and first ever-full time job in tech began right after completing university. This includes participants who were converted to fulltime employees after an internship or co-op as well and students who landed a job post-graduation (e.g., within six months) without prior organizational affiliations.

Transition into tech from non-tech industry – this transition describes participants who began their career journeys in industries other than technology, including more traditional engineering industries like aerospace, and non-STEM industries like retail, academia, and social services. Because this group represents individuals who essentially switched to a career in tech, pertinent STEM education and or certifications relevant to making the career switch are highlighted.

Transition from part-time or self-employment (in tech) to full-time in tech – this transition describes participants who worked in tech for several years but were not necessarily gainfully employed in the tech. These participants either worked part-time (e.g., in short contract roles) or operated a small business (e.g., offering web development consulting in your community) before landing full-time employment in the tech industry.

I now launch into narratives across the three transition groups to tell the stories of how participants entered the tech industry working full time.

4.1.1 From University to tech industry - internships, co-ops direct hire from undergrad/grad

In this section, I describe the four participants whose careers in tech began right after leaving their respective universities. Using quotes from each case, I tell a story of entering tech right after college. Each case is labeled with participant pseudonym followed by their latest known occupational role (as of October 2020). It is worth noting that participants in the university to industry group all possessed at least an undergraduate degree in computing or engineering before transitioning into working in the tech industry full time.

Hannah - Cloud Engineer

Hannah entered the tech industry directly after she graduated with a bachelor's degree in software engineering. Hannah developed her initial interest in tech in her pre-teen years. Specifically, she credits her interest in computers to the *"Black woman [that] came to fix our computers -she taught me."* What started out as a hobby (e.g., fixing computer hardware and learning new software) progressed into a career interest. Certain about her choice of major, Hannah went into college with the intention of getting a job after graduation. Networking with peers, Hannah recalls getting *"good advice"* from a male student that landed her the first job in tech. He advised her to *"do your [senior design] project using [this] software, it'll get you an internship."* The advice was good, during her senior year, Hannah got a position as a development intern for a tech company. The internship turned into a full-time opportunity as a junior applications developer for the same company. Hannah worked as a junior developer for a little over a year before finally landing a role as a software engineer.

After nearly two years in her role as a software engineer, Hannah grew discontent with her lifestyle. She experienced a shift in career motivation where the value of challenging work no longer motivated her. Really wanting to travel, she told herself she would *"accept the first offer out-of-state."* Eager to leave her home state, Hannah took a necessity approach to job searching and began applying to software engineering jobs all over the country. The shift in Hannah's career motivation after having professional work experience is more reflective of Hannah's shift in expectations of what a career meant for her life.

Hannah's career motivation was initially fueled by her value for the challenge her interest in computers provided, and a job was viewed as a source of stability and security. A career was a source of income, ideally gotten by doing what you like to do. For example, she found gainful employment as a software engineer and, for someone who spent their pastime building computers *"from scratch,"* she had landed her dream job. Later in her career, Hannah began factoring in her pay and the opportunity to travel as criteria to look for in a job opportunity. Having attended school in-state and now working as an engineer there as well, Hannah desired relocation. With the change in her personal motives her career in tech became a potential tool that could allow her the traveling lifestyle she ideally envisioned.

Unicorn Magic– Program Manager

Unicorn Magic completed both her bachelor's degree in computing and animation and her master's degree in management information systems prior to beginning her career in tech. She grew up playing video and computer games and aspired to work in animation, 3D modeling, and motion design. Though her school's resources were scant, Unicorn Magic's father made sure to have a computer in the home to keep her and her siblings abreast with using technology. *"My father worked long hours of overtime just to purchase our family computer, an hour a week in school learning how to type was not enough! […] He knew exposure was everything and now I know."* Through hard work and self-drive, Unicorn Magic made her own way to prepare for the rigorous college curriculum her public-school system did not prepare her for. Having a family support system was instrumental for Unicorn Magic's successful transition into STEM higher education. The negative feedback she received in her pursuit of a career in tech (e.g., *"someone that looks like [you]…does not achieve success in [the gaming] industries,"* did little to divert Unicorn Magic from pursuing her interests in technology. *"Fortunately, this was something I never heard at home.* Without role models, and no mentors to guide her pursuit of a career in animation and gaming, she opted to pursue a graduate degree, which was in part motivated by her desire to end up in tech, even if it was not exactly in niche field of her choice.

Unicorn Magic's early career motivations were rooted in needs-based career anchors (e.g., autonomy or the freedom to select her job content). Yet, traversing the challenge of attaining a STEM

degree without support for her career interests from mentors or role models, she relied on familial support and her own self-drive to accomplish her goals. Unicorn Magic acknowledges her fortitude in having had familial support at a minimum. *"I understand that everyone does not have that same experience and we have to be a village for our community. I am here to say, 'Yes, whatever you want in life is possible!'"* Intent on landing any job in tech, she used a necessity approach to her job search and began her full-time employment as a Telecommunications Team Lead. While grateful for family support, Unicorn Magic was woefully dismayed at the realization that more support was needed to help her navigate now that she made it to the tech industry.

Once she started working, she began to establish herself as an expert in information technology (IT). As Unicorn Magic focused on cultivating her expertise in IT, her career motivations shifted to talent, where she became intent on seeking jobs that further developed her technical competence. She stayed in her first position for nearly three years before leaving for another organization in tech. Unicorn Magic would continue to seek opportunities in the tech industry that fostered her subject matter expertise as an IT professional before her experiences as a Black woman in tech cause a paradigm shift in her conception of what career in tech would ideally look like if it were up to her.

Tonya - Sr. Hardware Engineer

Tonya began her engineering career in the tech industry while she was still in graduate school. She pursued her own start-up ventures while simultaneously finishing her doctoral work. Tonya found her interest in STEM, or electrical engineering, rather late. She remembers *"discover[ing] engineering [as she] was preparing for college […] senior year in high school."* Tonya did not have prior exposure to any advanced math, science, or coding courses before she arrived at a college, where she was *"encouraged to go the 'engineering undecided' route until [she] found a major."* Tonya says she knew that electrical engineering was for her from the first class as she *"was hooked on one intriguing and challenging project after another!"* Tonya received both her undergraduate degrees in computer and electrical engineering from a public land-grant university in the southern region of the United States. She went on to win a prestigious fellowship and completed a masters and doctoral degree in electrical engineering at one of the nation's top engineering schools.

Eager to find opportunities to develop her technical competence and utilize her entrepreneurial creativity, Tonya bolstered her education with both research and technical internship experience. Her internship experiences positively reinforced her engineering identity while she was in school. For example, as an undergraduate researcher Tonya designed a prototype and describes the fascination and realizations the whole research process had on her - *"from research, to modeling to actually building and fabricating it,"* she gained perspective on her capability as an engineer. *"After I was done, I took a step*

back and thought, Wow! I made this all myself […] I am a real engineer and I know what I'm doing!" Having made her own contribution and creating something that *"wasn't just a piece of someone else's larger project"* spurred her decision to go to pursue graduate school. Similarly, while on internship in the tech industry, her contributions to improve the process for manufacturing computer chips resulted in a new patent and her process modifications are still in use by the company in the present day (i.e., at that time of data collection). *"This work validated me as an engineer. People respected me and wanted to use my research."*

Tonya's initial interest in an engineering career was motivated by her value of challenging work: she was motivated when presented with complex problems to solve. With experience, Tonya's career motivations shifted from value-based to talent-based, where the point of a job changed from challenging her to cultivating her expertise as researcher and nurturing her entrepreneurial creativity (e.g., an interest in business products). Despite her stellar trajectory for a successful career in the engineering industry, as a doctoral student, Tanya found herself growing discontent. *"I felt that my research outcomes were distanced (and often times removed!) from the […] customers! I wanted to get closer to the product."* Leveraging the fact that she was still in school, Tonya explored entrepreneurship by taking business classes. Networking with her newfound business peers, she found a way to couple her research skills with *"customer-facing products at a startup."* Working as the Vice President of [Company Name] in mobile applications development during the day, Tonya finished her graduate studies at night. Tonya's contribution to the start-up led to their product getting acquired by [Company X]. Subsequently, her talent and experience also led to her recruitment by the [Company X]. Tonya eagerly accepted the career opportunity and was onboarded as a Senior Hardware Engineer; she has remained an employee at Company X concurrent with this study.

Yana - Principle Engineer

Yana's engineering career in technology began in a traditional fashion (e.g., she progressed directly from higher education to workforce). Yana attended a state university where she majored in computer science. She completed her undergraduate degree while working as a student intern for a small company. Upon graduation, she began working fulltime as a systems analyst for her university while concurrently completing her Master of Science degree in computer systems management.

Yana's early career decisions were anchored in developing her technical competence and finding opportunities to test her aptitude *"to do the work"*. Her decision to pursue tech was largely value-based. She enjoyed the challenging nature of the work. In reflecting on her career journey, Yana considers herself *"fortunate"* that, not in any way, has she *"been stymied from what I wanted to do [in life]."* Naming her grandmother as one of her greatest inspirations, Yana contributes her *"all things are*

possible!" mindset to her late grandmother's lived example that *"the only limits we face are the ones we allow to be placed there."* Regarding her chosen field and the industry, she works in, Yana understands *"…as a woman, but also as a Black woman […] I know that walking in the door, I have to assert myself probably more than my colleagues in demonstrating what I know."*

Aware of the small percentage of Black women with computer science degrees, Yana uses her self-drive and focuses on her ability to do the work. She acknowledges the added layer of scrutiny that comes with being hypervisible at work: "*Just to put the numbers out there, between 1% and 3% of computer science degrees are awarded to African-American women. That's really specific. So, I know that I am rare, but at the same time, my work speaks for itself."* Her hard work and mastery-oriented mindset have afforded her a high sense of self-efficacy when it comes to her capabilities as an engineer. Though she works hard and has a tenacious attitude, Yana admits that she did have help:

> *"I've been fortunate that I've had people who helped me along the way […] there are people who have supported me along the way always in my career, and helped and guided me, who did not look like me at all. That has been important for me. That is, unfortunately, not a shared experience for many women in technology"*

With the advocacy of allies, Yana has been able to curate her career in tech for the past 20 years. She worked in her first role as a systems analyst just under two years before moving on as an application engineer for a fortune 500 telecommunications company. Yana's tech career journey is dictated by opportunities, specifically opportunities to challenge herself, including shifts in technical niche areas (e.g., shift from software engineering to big data). Having nothing less than stellar results in her work history, even her colleagues note how impactful her contributions are in the workplace.

4.1.2 Switch from Non-tech Industry – includes retail engineering, math education to tech

In this section I describe the ways Yasmine, Tiara, Ashley, Jocelyn entered tech fulltime after having begun their careers in other industries. Though all four participants enter tech from non-tech industries; two have STEM degree backgrounds and two have non-STEM degree backgrounds. These four industry switchers (e.g., non-tech to tech industry) are an illustrative example of the spiral career concept outlined in the CCF framework. As a reminder, the spiral orientation is defined as individuals who consciously or otherwise make a major career changes in 5-10-year cycles and fits the change in industry exemplified by this cluster of participants. Below I tell the tech entry stories of Yasmine, Tiara, Ashley, and Jocelyn to describe nuances in career motivations and strategies that yield different expressions, or career patterns for each participant. These stories demonstrate the shortcomings in the CCF.

Ashley – Chief Executive Officer, Co-founder

Ashley left her career in a more traditional engineering industry to start her own company in the tech industry. Her career shift was achieved by her self-directness and driven by her strong personal values. To give some background, Ashley has a formal education in engineering, receiving both her bachelor's and master's degrees in aerospace engineering. As a successful community college transfer, Ashley received both her degrees from [State University]. Both hard working and talented, Ashley's career interest in engineering was undergirded by a value-based anchor (e.g., for the pure challenge - *"The whole idea of waking up every day to work on something that would go into space was exciting,"* she said. Working at [company X] would be *"badass"*). Ashley says her journey through engineering was achieved by focusing on *"a series of small wins,"* (e.g., like getting all A's in a semester). In graduate school, she was able to leverage her network to land an internship with her dream organization (e.g., company X). She was converted to full-time engineer after her graduation.

Thriving as an engineer in her dream working for company X, Ashley's first job was also a period of discovery in terms of her career anchor. While the pure challenge of engineering was something that motivated her, new experiences at work began shifting or uncovering some of Ashley's hidden values. She began re-evaluating some of her own career experiences and expectations. For example, when serving as a liaison in her employers STEM outreach programs, Ashley noticed that a lack of engineering representation among communities of color made it difficult to *"even share what I did at my job… [the students] had never seen someone like me, I did not fit what an engineer was."* Though she was satisfied with the technical components of her work and had already received her second promotion, Ashley *"[wanted] to take the impact that [she was] having in [her] profession and translate that into the community […] my interests were different, and my goals were bigger than [engineering organization's] mission."* It was through self-reflection that she realized that she wanted a career that spoke to her values directly.

> *I was not speaking wholly to who I was as a person in that job! AS A BLACK WOMAN, I, AS SOMEONE WHO KNOWS WHAT IT IS LIKE TO BE POOR, AND WHO DOESN'T HAVE INDUVIDUALS AROUND ME THAT HAVE GONE OR BEEN IN ENGINEERING AT THAT LEVEL.* [emphasis in original]

Ashley envisioned working at a sustainable company that develops leading technologies for clients and *"allows us to give back, not just to the communities we care about, but the nation as a whole."* She switched to an engineering consultant role for company X while she built her company. She continued her engineering consulting for two-years before she stepped in her full-time position as chief executive officer (CEO) of her own tech start-up.

Driven and highly motivated with a clear sense of how she saw her values in relation her technical abilities, Ashley bootstrapped her tech start-up. With no outside resources, aside from securing the first government contract, Ashley built her company from the ground up. Because Ashley's first role in tech was entrepreneurship, I compare her strategy for obtaining start-up funds similar to how I discuss other participants job search strategies. In attempting to launch the company Ashley made two trips to Silicon Valley to try and find investors. Her first approach to find investors to start her company align with the necessity-based approach; she entered pitches and seemingly spoke to anyone who would listen. Not having any luck, Ashley switched her approach and instead used her network to find another talented colleague. Together they used their engineering skills to bid on *"only the most challenging [government] projects."* Securing their first bid, meant that their company was "case positive" and had some stability as the projects typically lasted several years. Still very much motivated by a value for challenging work, Ashley decided that she still wanted to be an engineer, but in her own way and for her own reasons.

Jocelyn, Robotics Engineer and Founder of [Company W]

Jocelyn's career experiences began earlier than most. By her late teens Jocelyn had been running a multi-million-dollar company in the retail-service industry for several years. Facing some beauty related issues as a young teen, Jocelyn invented a product to help solve the personal problem she was having. Driven by entrepreneurial creativity and aided by access to STEM professionals and mentors across industries, Jocelyn created her own company as a teenager. Jocelyn credits the entrepreneurship program as presenting her with *"opportunities [that] really changed my life trajectory."* Despite her wildly successful business, Jocelyn reflects on her early entrepreneurial career as *"a small distraction to a new career"* and mentions that she *"kept it up for practical reasons, but there are no robots [here]".* See, as an eight-year-old child, Jocelyn had been fascinated with robots; however, her seemingly overnight success with her company led her away from her true career interests.

With her company thriving, Jocelyn *"summoned [her] courage and all [her] might"* as she decided to switch gears and pursue her childhood interest in robotics. The life events that led to her entrepreneurial success in the retail-service industry had deterred her STEM interests for nearly two decades. Jocelyn leveraged higher education to aid her transition into tech from the retail-service industry. She went on to receive a bachelor's degree in computer science and received a master's degree in design engineering while continuing to run her company. Partially due to her entrepreneurial success, more specifically the extra-organizational network it afforded her, Jocelyn was able to land internships in tech while she earned her degrees. She balanced working for the university during the academic semesters and did tech internships with industry during her summers. She also functioned as a director for a university enrichment program, mentoring and educating others on how to run a business. Relying on her already

established industry networks to locate job opportunities, Jocelyn began her first full-time role in tech as a project manager with a company she had interned with during her undergraduate time of study.

Though her transition into tech was also preceded by University, Jocelyn's career started in a separate industry and makes her decision to pursue a formal STEM education more of a strategic move to aid her switch in industries. The following quote is helpful to understand why Jocelyn elected to pursue a career in Tech *"I love that technology enables access to information. I've always wanted to be a maker of things."* Jocelyn's career decision to pursue robotics and *"discover my humanity through technology"* was rooted in a value-based career anchor. Her view of s career is beyond just a job, it is closer to that of a calling. When asked to define success, Jocelyn said *"Success for me is more than awards and milestones. I want my potential for impact to rise."* Jocelyn approaches her robotics work with a practice of mindfulness and employs metacognitive skills when evaluating her career options and decisions. *"When I make decisions, I think about who I will impact and what the work will do for my life."* She sought a career where she could leverage her technical expertise into meaningful impact. Jocelyn viewed her interest in robotics as a conduit to work for the greater good of communities. She chose to pursue a career in tech to uplift her community and fulfill her entrepreneurial creativity by pursuing roles that enable her to create.

Yasmine – Senior Engineering Program Manager

Yasmine entered tech from the retail industry. Though they graduated from a top college and had a great GPA, they initially had a tough time getting interviews. Yasmine entered tech with a non-STEM degree. However, she was concurrently pursuing a master's degree in management information systems (MIS) when she landed her first tech job as a product support specialist. Learning from peers and friends who were getting interviews, Yasmine got more intentional with showcasing *"what I could do versus what I had learned."* For example, engaging in *"conversations in your chosen field on sites like Quora, LinkedIn, industry forums, Stack Overflow, etc."* as well as setting up a website (e.g., GitHub) to *"show some of the projects that you have done".* Mapping to the spiral career concept in the CCF, motivated by a desire for personal growth followed by a change in industries, Yasmine found an interest in product and took to becoming a subject matter expert (SME) on the topic. Though the MIS degree does *"open a lot of doors and often make[s] the job easier in terms of relating to the engineering team,"* Yasmine primarily read books and blogs on product development and attended meetups for product development in their area to aid the transition into tech. Yasmine aimed to specialize in product and developed interesting strategies (e.g., intentional searching and recruitment) using online tech communities to kick-start her own career in the tech industry.

Initially lacking the resume to break into tech from the retail industry, Yasmine found online *"groups that have hiring managers"* for the positions she was interested in and *"ask[ed] them to take a look"* at her resume. Additionally, she joined *"every group/forum that talk[ed] about [product management] and join[ed]."* Her strategy for breaking into tech, and the advice she gives to others, was to *"essentially raise your profile as a thought leader on* [desired niche in tech] *and use the internet's SEQ to help recruiters find you instead of you needing to apply. I used this template to break into product management after not having the background, to great success."*

Yasmine's tech Career anchor emerged as need-based. For them, the need for autonomy (e.g., personal freedom in job) as well as lifestyle motivations (e.g., balance work and community commitments) are directly related to their motivations for pursuing a career in tech. Yasmine considers themselves a *"social change evangelist*." Tech is a part of how they do it, but at their core they are dedicated to working for the greater good of the LBGTQ+ community.

Tiara, Chief Operating Officer

Tiara rediscovered her interest in STEM after working for a non-profit. Like many recently graduated students, Tiara was uncertain about what she wanted out of a career upon completing her bachelor's degree in sociology. Ready to start work, but unsure of what she wanted to do, Tiara began her career from a needs-based career anchor. She took an opportunity to gain some experience by joining a national service agency (e.g., AmeriCorps Vista). During her year with the non-profit organization, she was a math tutor and counselor for kids. A turning point in Tiara's career trajectory occurred when she reflected on why she herself had never considered pursuing a career, or even an undergraduate degree, in a STEM field.

> *My service term as a […] tutor was a spirit awakening experience that lit a spark in me I had inadvertently stifled."* She recalls that *"fond memories of childhood technological curiosity and exploration were forced to the backmost region of my mind, so much that I studied sociology in college without consideration of a STEM career.*

Through reflection she came to realize: *"my passions for technology were not a priority to me,"* and so, she became intentional about prioritizing her passion.

Having rediscovered her interest in STEM, Tiara broached her career in tech from a value-based anchor. Her motivations to pursue a tech career was motivated by sheer interest and the value of the challenging nature of the work. Leading with her passion(s) she enrolled in a full-stack coding bootcamp that lasted several months. She earned her certificate in software engineering and went on to work as a software developer for a small tech startup company. The organization was her first full-time employment in tech.

Tiara was eager to get enmeshed in her field and leveraged her self-driven attitude to continue learning new programming languages and fine tuning her software development skills. Working for a smaller organization meant that Tiara was presented with developmental opportunities. She also took on more functional roles (e.g., web developer for the companies digital marketing) to help push the organization forward. Tiara found fulfillment in her job and was able to further develop her own tech skills and teach others like herself in the process. She found satisfaction in knowing that the organization she worked for lived up to their commitment to diversity, equity, and inclusion in Tech: *"Working within an organization that not only understands the diversity deficit and plight of women within the tech industry, but spends every day getting things done to do something about it, has been empowering."*

As Tiara gains experience, she discovers that aside from enjoying the sheer challenge that coding work provides, she also has a deeper conviction for choosing Tech. The environment provided by her organization is one in which Tiara could thrive. She balanced her duties between software development and digital marketing for the organization for a year and a half before getting a promotion. Her career trajectory is one of the only trajectories in the study to follow a linear path upward within the same organization. As Tiara continues to scale the career opportunities within her organization, her dominant career motivation shifts from needs-based (e.g., personal freedom in job content) to a value-based career anchor (e.g., pure challenge and dedication to a cause). Reflection was a key practice in unpacking her early deviation from a career in STEM, and it also led Tiara to find her "why" as she made her way back, in the pursuit of a career in tech.

4.1.3 From part-time and self-employed in tech to tech full time employee

In this section, I describe the tech entry of participants Yvonne and Candace. These two participants share similarities in their educational backgrounds– they are both self-taught software engineers. One of the key differences between Candace and Yvonne is namely their total number of years in the tech industry. Candace is one of the most experienced participants, with over twenty years in tech, whereas Yvonne is the earliest in her career, with less than five years in tech. Below I provide more details on the nuances between these women's career motivations and subsequent career strategies.

Candace - Product Marketing Manager

Candace is an *"autodidactic engineer" and* entirely self-taught. Her first full-time role in tech was as a Quality Assurance Analyst, where she stayed for just over 3 years. Candace credits her mother's foresight to pointing her in the direction of technology and cultivating her into a self-directed learner. When Candace was 11, her mother handed her a programming book and software book and said, *"you are going to do this every day until you figure it out."* A few years later, Candace's brother introduced her to

HTML, and she began toying with making websites. By the age of 16, Candace had developed a small business doing web development and IT work for businesses in her community. In her late teens, faced with the financial responsibility of her mother and younger siblings, Candance attended a community college where she worked multiple part-time jobs as a tutor, teaching assistant, and as a help-desk technician to make a living. She graduated with an associate degree in graphic design.

Candance was talented and had a knack for coding. Her early career motivations in tech were a combination of both talent- and needs-based motivations. Her mom was her inspiration to be an engineer, as she wanted to give back to her mom and be able to take care of her. Candace's need for security and desire to *"make money"* to provide for her mom and siblings, coupled with her entrepreneurial creativity, led her to a career in the tech industry. Even though she lacked the formal education, Candace *"believed"* in opportunities and *"lept"* on chances to advance her engineering career because of her faith. *"When I was interviewing for jobs at companies that required degrees I didn't have, my faith was there."* In addition to trying to prove herself qualified for positions she was interested in, Candace said that throughout her career she has had to deal with people underestimating her abilities due to her informal education. Candance has a direct approach for dealing with naysayers: *"For the doubters there are 3 ways to handle it: ignore it, address it via communications, or flat out prove them wrong.… When people make assumptions about you. You have to really know yourself, what you value, what inspires you. IF you have that you can do anything."*

Candaces' curious and self-driven nature to learn and explore tech led her to hacking installers and registry keys for [Company F]. This experience turned into a full-time job offer doing quality checks for [Company F]. Candace worked as a quality assurance analyst for a little over three years before moving on to another opportunity. She attributes her work ethic to her faith. She says that praying always *"affirms the outcome will eventually favor me,"* and that knowledge gives her the inspiration to take chances on job opportunities she may not otherwise have considered.

Yvonne - Software Engineer

Yvonne, like Candace, is also a self-taught engineer. Her tech story begins as a single mom in a shelter. Desperately needing to find gainful employment, Yvonne joined a one-year work development program. She selected the information technology track and began her six-month corporate internship at the end of her program. Yvonne had trouble finding full-time employment though, searching for nearly four years. During those four years, she was employed across four different organizations in various temporary or part-time web developer/coordinator roles. In reflecting on those early years trying to break into tech, Yvonne said *"they all said they couldn't hire me because I didn't have a college degree."* Though her lack of a formal degree was a hindrance, Yvonne was determined to continue

developing her tech skills and become an engineer. Yvonne exhibited a strong self-drive as she worked to transition into tech. Looking for more opportunities, Yvonne took her children and moved across states. Regarding her decision to relocate, she says:

> *[I] decided to relocate to [city] at the beginning of [201X] to start a new life in a city that I was somewhat familiar with. I had heard that the Tech scene in [city] had been developing and since my contract with [University] was ending soon, I felt like that was the universe give me the green light to take a chance and start over fresh. I was able to secure an apartment for my boys and I and immediately started the dreaded job search after. I had been meeting with different recruiting agencies, sending out hundreds of resumes, and it always ended with similar if not the same results …* - 'Dear Ms. [Surname], we appreciate you coming in to interview with us but at this time we are looking for a candidate with a little more experience.' *Can you say discouraging! I began to doubt myself and my decision to move my little family to [city].*

Without any job prospects, Yvonne moved her family closer to potential opportunities. It eventually paid off. Though her decision was bold, Yvonne eventually resorted to her communication skills and abilities to network to find a job in tech. Yvonne took to social media (e.g., LinkedIn) to network and find local meetups to attend. As she worked to improve her tech skills, her self-driven attitude led her to reach out to employees in tech who worked for companies she was interested in. Her cold calling of employees, indirectly worked to her benefit. She found someone willing to take a chance on her and received a 6-week contract role that turned into a 6-month internship. At the end of six months, she was offered a full-time position as a software engineer.

Yvonne's entry into tech epitomizes the construct of being physically boundaryless as she willingly moved geographically to increase her chance opportunities to build her job experience. Yvonne says *"If you're in a bad situation, it doesn't have to define you. As long as you want it, you can achieve it."* Though her path into tech did have its challenges, the experience birthed a mission in her: to pave the way for others *"… and help people see that you don't have to go the traditional route to be successful."* Though her career decisions were primarily motivated by necessity (e.g., providing for her kids), Yvonne's primary career motivations began to shift toward talent-based with experience. She stays at this entry level software engineering job for a little over a year and half, before moving on to new opportunities for career development.

In Section 4.2, I summarize participants career history to-date and shed light on their values and the underlying psychological components (e.g., attitudes) that enabled these women to obtain subjective career success. I also trace how shifts in work and life balance influence Black women's career mobility strategies.

4.2: The influence of values on participant's career decisions

To fully answer RQ2: *How are Black women's career decisions and outcomes influenced by their values?* I had to first answer: *What are Black women's values?* In this section, I present findings to answer both questions. In answering RQ2, I found that while all the participants held personal values, not every participant had value -based career motivation(s). Furthermore, for participants who did have value-based career motives, not everyone used their values to inform career-related decisions. However, it was important to readily identify *what* types of values participants had to determine if there were any shared values or patterns in how they may have structured the obligations to their personal values in relation to their professional roles. Additionally, some participants early career motivations shifted with experience. For example, some participants did not originally have a value-based career motive but, through industry experience and a *process of discovery,* eventually became aware of values—a realization causing some of them to switch career course or adapt their mobility strategies.

In this section, I describe a shared value of community across all 10 participants. I provide example quotes with themes on self-awareness and outline the impact of self-reflection on participants work values in terms of their career self-discovery process. Before launching in the findings for RQ2, I provide an overview, see Table. 11, with a snapshot of each participant's career history in tech. The table includes participant educational backgrounds, context for their transition into tech, the total number of organizations they have worked for, their total number of years in tech, and their last known job title. In the next section, I end section 4.2 by describing the psychological dimensions of participants that enables them to navigate their tech careers to their own satisfaction and success.

Table 11. Overview of Participants Tech History

Participant	Degree(s) 1.Undergraduate 2. Graduate	Entering Tech from…	Early Career Motive	Established Career motive	# Orgs	Most Current Role in Tech	Tech Tenure (Years)
Hannah	1. Engr. (B.S.) 2. Engr. (M.S.)	University	Talent	Talent/Needs	6	Sr. Cloud Engr. Advocate	11+
Unicorn Magic	1.Computing (B.S.) 2.Computing (M.S.)	University	Talent	Value/Talent	6	Sr. Project Manager	11+
Tonya	1. Engr. (B.S.) 2. Engr. (M.S./Ph.D.)	University	Value/Talent	Talent	3	Sr. Hardware Engineer	6+
Yana	1. Engr. (B.S.) 2. Engr. (M.S.)	University	Talent	Talent	9	Principal Engineer	22+
Ashley	1. Engr. (B.S.) 2. Engr. (M.S.)	Engineering Industry	Needs/Talent	Value	1	CEO/Founder	11+
Jocelyn	1.Computing (B.S.) 2. Engr, (M.S.)	Non-tech Industry	Talent/Value	Value	4	Product Manager	9+

Yasmine	1.Liberal Arts (B.A) 2.Computing (M.S.)	Non-tech Industry	Needs	Talent/Value	8	Sr. Data Product Manager	10+
Tiara	1.Social Science (B.S)	Non-tech Industry	Needs	Value	1	COO	6+
Candace	1.Liberal Arts (A.A)	Self-employed	Needs/Talent	Value/Talent	3	Sr. Manager Product Marketing	23+
Yvonne	n/a	Part-time Tech	Needs	Value	3	Documentation Engineer	3

4.2.1 Shared values - Community

Across all ten participants there was a shared theme for the value of community as it related to their tech careers. Loosely defined, the theme of community refers to:

> **community** -*the groups of people who participants identify with (e.g., have a particular characteristic in common with) and or share common attitudes interests' challenges and goals with. This definition is inclusive of professional communities (e.g., other Black women in Tech), and local communities (e.g., schools and non-profit organizations).*

The cross-case analysis revealed a relationship between work and community that impacts participants career decision making and their overall career outcomes. Community, as a personal value, was a common theme expressed among participants, functioning both 1) as an underlying career motivation and 2) as a form of professional networking to find career opportunities and seek mentors for career development. I will cover the latter function of community in more detail in section 4.3. However, when comparing the ten cases across the shared value of community for career motivation, I identified three different ways Black women in tech enact their value of community in career-related decision making. To a degree, all participants shared the value of community, with specific emphasis on giving back. Of particular importance was the shared objective to evangelize tech, or leverage their professional resources/skills to marginalized communities to aid with access to technology as well as foster awareness and feasibility of career opportunities for minorities in tech. Despite this shared value, each woman navigated their career differently. I selected illustrative quotes of the role of community for participants work in tech.

There were three main combinations for how the value of community was structured in participants lives. Briefly, Table 12 includes descriptions of the different work-community relationships as well as how cases mapped to each work-community combination. Though I have labeled and briefly defined the three ways participants structure their value of community alongside or intertwined with their

tech careers, I use the rest of section 4.2 to illustrate differences using narratives of participants lived experiences.

Table 12. Overview of Participants Shared Values

Combination	Description	Participants
Two for One	-community value is primary priority in-line with company/org mission and vision alongside technology	Ashley, Tiara, Unicorn Magic
Two Hats	-community value is secondary time commitment, for example: professional self is leveraged to volunteer time outside of work (e.g., tech based non-profit focused on STEM education and tech evangelism).	Yana, Candace, Hannah, Tonya, Yvonne
Two Passions	-corporate tech job and non-tech community engagement	Yasmine. Jocelyn

4.2.1.1 Two for One

I provide narrative quotes from participants who have combined their value of community directly with their role responsibilities in their tech careers: **Ashley**, **Tiara,** and **Unicorn Magic.**

Ashley's value of giving back by using technology to empower are the reasons behind her switch from engineering industry to tech entrepreneurship. As CEO of her own company, Ashley was free to declare a two-pronged mission on behalf of her company, where one half of the mission is focused on engineering (*"I want to build bad-ass technology")* and the other part of the company mission is related to community outreach *" but also teach how we did that to people who otherwise would not have access to us, people we do not know, who are not related to us, who are not paying us."* This value of giving back stems from her belief in *"democratizing technology, for me it is the great equalizer."* In reference to one of her companies outreach programs, she stated, *"That's how we started, kids making companies before they graduate high school; even if you don't like engineering, it's not a requirement. I am going to show you the fundamentals of how to create a prototype, create a business plan, and how to pitch your company."*

Tiara believes that it is part of her personal mission to *"change the landscape of the tech industry, but to help other women and diverse populations change the trajectory of their lives."* Knowing *"that women in STEM careers, like software engineering, have a higher salary than their non-STEM counterparts by an average of 33%,",* made Tiara want to see more women considering STEM careers. It

was also, she realized, a career that she wanted for herself as well. She finds employment with an organization that has a community centered focus and shares her values of supporting diverse women in tech and talks about how that can be empowering. *"Working within an organization that not only understands the diversity deficit and plight of women within the tech industry, but spends every day getting things done to do something about it, has been empowering."* Having settled on her passion of bridging the tech divide among women and diverse communities, Tiara's community-work relationship culminates in multiple years of *"teaching and developing curriculum for software development."* Tiara engages regularly and meaningfully in online communities, leveraging her software development skills to help others. On her personal website, she showcases the projects and programs she has built on the side. Her value of community engagement has potential to turn into an entrepreneurial opportunity. She has presence on multiple sites where she showcases the projects and solutions she has developed for others. *"Okay friends just documented my solution to setting the form field for when the request is submitted via the form to the current date and time. Here's how I solved it: [link to personal site]."* In her online engagement, Tiara also does live streams of herself learning code for accountability, transparency and as a guide on how to learn software development. For example: *"Pop up #livestream! I'm still in the beginning stages of learning #RubyOnRails. If you want to come learn with me, I'm about to start a livestream on #twitch."*

Unicorn Magic's experience as an *"aspiring techie with little to no resources to pursue her dreams [and seeing] little to no reflections of herself in tech roles and leadership"* are at the center of her tech advocacy work. She aims to *"bridge the diversity gap by educating, breaking down barriers and providing access to resources."* Regarding her community, Unicorn Magic is trying to show people from her community that a career in technology is a possibility for them and to show society that women of color are capable of:

> *"achieving excellence against the odds stacked against [them, it] is PURE MAGIC!"* She is also quite candid on the importance *and "honor to be a voice for [her] community and serve as a role model on a mission to change the face of technology. […] When working with the youth, many aren't able to visualize themselves in technology roles or starting businesses or anything outside of sports and entertainment. […] Outside of that, society could not visualize women and people of color in a leadership role."*

Unicorn Magic has realized the importance of awareness (e.g., of options and opportunities) regarding making informed decisions and reaching her fullest potential and has leveraged that knowledge to become an advocate for other Black people in her own community.

4.2.1.2 Two Hats

I provide narrative quotes from participants who have combined their value of community as it relates to broadening participation in technology a secondary time-commitment outside of their role responsibilities in their tech careers: **Candace, Yana, Hannah, Yvonne, and Tonya.**

The two participants with the longest working history in tech, Candace, and Yana, have active lives working with tech-related non-profits that are separate form their full-time responsibilities in tech. Candace is a huge proponent of telling others to center their career decisions on their values. She perceives her role in engineering as an opportunity to *"act out your values in the world, whatever is most important to you".* For Candace, the wellbeing of fellow humans is a core value. This value is evident in the nature of the two non-profits he launched to service her local community and communities of working professionals. While one of her organizations incorporate STEAM principles and design thinking to target solutions for community-based violence, her other organization helps drive organizational change that promotes individual satisfaction and work-life integrity. Candace has worked in tech for over two decades, but she considers herself to be *"[an] evangelist for equality"* and an *"advocate for equity".* Yana, on the other hand, uses her personal life to cultivate the inspiration for her tech career. *"The history of my family is rooted in community service; everyone from my grandmother to mother and aunts have worked in education or social work. So, my inspiration [to be who I am] is driven through their example of giving back in a meaningful way. […] to help girls who look like me, to tell them that they are welcome in this field too."* Serving as a co-director of a local non-profit tech organization for the past eight years, Yana uses her free time to empower young and aspiring black technologists and engineers.

With about half the career experience of Candance and Yana, Hannah similarly invests a considerable amount of her free-time working in her community to advance technology education and outreach. As an adjunct professor, she teaches web development at a junior college in her area. She also volunteers as a co-organizer for a monthly tech meet-up in her town. Though her role as a co-organizer can *"be overwhelming"* in addition to her full-time job she gets help from the team. She is largely "*in charge of communication with speakers, [ticket sales], making sure attendees have someone to talk to if they feel uncomfortable, [as well as] setting up for […] coworking events held in the daytime."* Hannah finds that the most 'valuable thing that existing women in technology can do to support minority groups in technology' is to *"promote and support them."* She emphasizes that something as seemingly miniscule as *"retweeting a diversity scholarship for a conference, to paying someone's ticket"* to attend a conference are great ways to promote and support minorities in tech. As far as helping more junior developers advance in their skills, Hannah believes in *"leading by example"* and giving them *"implicit*

and explicit permission, and the space to make mistakes and ask questions […] we need to be more vulnerable and show that despite being further in our careers, we still make mistakes and learn every day." As a co-organizer for the tech meet-up Hannah plays a key role in creating the "*space, they […] need to feel safe enough to make those mistakes and feel comfortable … asking questions"* whether they be "*minuscule or repetitive."*

Although Yvonne has less than five years full time experience, she shows signs of viewing her career as a calling. As she discusses what her struggles were as she transitioned into tech, she says the following:

> *"I'm completely self-taught. So, like I taught myself web development using You Tube. Yeah, and so I had to figure out a back and front end and not like it was the line was kind of blurred for me. You know, which was front and back end, but I learned quickly the difference because front end is like so much more like a filling to me."*

Now that Yvonne has found a career that fulfills her passion and helped turn her life around, she is eager to help others realize and do the same. *"And that's where I want to help. Because I know the things that struggle with, you know, trying to learn. And so like, I want to be that voice or others that, you know, I want to break it down so they can understand and not use a lot of big terminology."* She highlights that one of her biggest struggles as a self-taught engineer using open-source software and free online tutorials was sifting through the tech jargon that is confusing for newcomers. "A lot of people don't teach the same and they don't break it down so that newer engineers or you know, someone that wants to break into the end industry can understand." To achieve this goal Yvonne has added a non-profit to her resume.

> *I am currently starting my own chapter of [nonprofit name]. So, it's a nonprofit that, you know, empowers women and anyone that, you know, classifies themselves as a woman. It empowers them and helps them on their journey throughout tech. So, it's free, free, free to low costs, courses, and classes and like you know, mentorship and you know, that kind of, you know, You're not alone in this.*

Yvonne will likely continue to develop her expertise as a software engineer and remain in tech for life if she can continue to find meaning in bridging the gap between tech and the communities she cares about.

For some participants, the value of community was a way to simply give back. For example, Tonya spends her free time volunteering for STEM scholarship boards, and nonprofits focused on *"providing technical, and research experiences for minorities and women."* For Tonya, the phrase *"generosity is our privilege"* captures how she leads her life. Having been *"deeply involved in engineering education and outreach,"* while in graduate school, Tonya now she spends most weekends

either teaching electronics at her alma matter or *"volunteering to run workshops and science fairs."* Irrespective of how the value of community was enacted, participants found it important to combine their experience and skills in technology to pay it forward for the next generation of aspiring engineers.

4.2.1.3 Two Passions

I provide narrative quotes from participants who share a strong value of community in-directly with their role responsibilities in their tech careers: **Yasmine and Jocelyn.**

Yasmine's engagement with communities is not dependent on their identity in tech. For example, concurrent with their career in tech, Yasmine has risen to the *"highest level of influence in [the LGBTQ+] community."* Yasmine came to terms with their gender identity as they worked to transition into their first role in tech, "*I am a trans nonbinary lesbian and … My life … has been fundamentally moved and influenced by love of my trans siblings and more specifically my Black trans siblings."* As a *"social change evangelist"* they have worked extensively and consistently with nonprofits for nearly ten years. Part of their motivation for pursuing a career in tech is for the lifestyle it affords them. Yasmine has the flexibility and resources to devote much of her free time to making an impact for the broader LGBTQ+ community something they are deeply passionate about.

As someone considered a dual-careerist, Jocelyn has been a pioneer in the natural beauty and retail business. While Company W now delivers products for a "*growing multi-cultural base*," it began by catering to the retail needs of women of color. Jocelyn manages her company while actively working full-time in tech. As a person with essentially two careers, *"the hardest thing is managing my travel schedule. Sometimes I have to attend meetings in different regions of the world at the same time."* In attempts to stay committed she keeps a clear sight of her passions as she *"imagines a world where young black women will lead innovative businesses and impact technology."* Having combined her passions, she charts her own trajectory in tech and in business and makes room for others who wish to follow in her footsteps.

In the following section I describe some of the psychological dimensions that enable participants to be value-led in their careers and aid them as they strive for subjective success and career satisfaction.

4.2.2 Psychological Career Dimensions

In this section, I use select narrative-style quotes from all ten participants to highlight the themes related to the psychological dimensions of their career concepts. The themes presented herein help to characterize the personality traits that enable participants to lead their own careers with both satisfaction and success

irrespective of their underlying career anchors. In Table 13, I provide brief definitions of the major psychological themes and sub-themes that capture the essence of the findings for RQ2. Specifically, *mindset* was a code that ended up summarizing a major theme that emerged across participants. There are several sub-themes related to mindset: adaptability, self-directedness, and self-awareness.

Table 13. Themes - Psychological Career Dimensions

Theme/Sub-them	Working Definition
Mindset	an attitude that enables participants to complete challenging work, mastery orientation, or growth mindset conducive to career goals.
Self-awareness	a conscious understanding of oneself (e.g., motives, feelings, and desires, needs), evidenced by the practice of self-reflection both formally and informally
Self-directed	Demonstrating initiative and self-discipline in the process for self or career development; the ability to regulate and adapt behavior to demands to achieve personal goals
Adaptability	The ability to adjust to new or changing conditions, (e.g., change tech niche areas, switching from software engineering to data science)

These sub-themes thematically relate to the degree-to-which participants were value-led in their careers and had influence on their career mobility (e.g., deciding when to leave or influencing their subsequent job search strategy). Though these themes were present across all 10 participants, I classify participants into three main groups to emphasize the degree to which they are value-led compared to one another. I classify participants as being primarily, secondarily, or non-value-led in their career decision making but this distinction is just a relative categorization based on their available career data and should not be taken in the absolute. As the previous section 4.2.1 demonstrates, all the participants held personal values but the degree to which those values showed up in or alongside their career decision-making varied across their experiences.

4.2.2.1 Primarily Values Driven

Yasmine

Switching industries and coming and starting a career in tech before they began their graduate studies in a computing field are both contexts that allude to Yasmine's self-directedness. Yasmine is a great example of how being self-directed lent itself to her ability to work her way into her desired niche within tech (i.e., product) after leaving the retail industry. Yasmine describes her approach to increasing her job opportunities. "*When I was not receiving many interviews. I started doing some research" (e.g., interview tips from human resources found online and studying peers in her network who were getting interviews)."*

She decided that she needed *"to differentiate myself by showing what I could do versus what I learned."* Self-directedness requires both discipline and focus, for this Yasmine suggests "*focus [your desired are of self-improvement] on an area or 2 at most and then also stay abreast of general trends in the industry."*

Candance

Though self-awareness can be advantageous for anyone, it proved to be especially useful for Candace who had a non-traditional background as she transitioned into tech. I use quotes from Candance that illuminate how self-awareness (e.g., interests, wants, needs, abilities) is instrumental for her intrinsic motivation. As a self-described *auto didactic* (e.g., self-taught) *engineer,* who has worked in tech for over twenty years in nearly all niche areas of the technology sector (e.g., engineering, marketing, sales, research, artificial intelligence, product), speak volumes for Candance in terms of being self-directed and adaptable in her technical skill set. When asked what advice she would give her younger self, Candace noted the critical importance of self-awareness at the outset of her career. Candance said *"find out what's important to you, ask why, and never give-up and believe that whatever you want to do is possible even if other say nay, and find people that can help you."*

Unicorn Magic

As an entrepreneur, who also works a *"9 to 5 and taking care of my family […] and all that stuff it's so much going on, it's like you have like twenty-four hours in day you got to figure out, ok how many hours are going here, what do you have left…"* Unicorn Magic follows a prescriptive mechanism to keep all her priorities in balance. *"One of the mechanisms that I use is uh uh I think its rock pebbles sand in a glass, so what that means is, in your life there's things that are rocks, there's things that's pebbles, there's things that's sand that just falls by the wayside." […] At the end of the day your glass is gonna be full, so you have to decide, what's going to be a rock in your glass, what's going to be sand at the bottom, what's going to be small pebbles, its priorities."* Having a solid grasp on the rocks in her life (e.g., family events) helps Unicorn Magic self-direct her time management and stay consistent in the important things in her life. With the awareness that both time and her energy are finite, this mechanism and iterative reflection on her goals and priorities help her maintain a sense of integrity among all the roles that she occupies between work and home life." *You're doing so much, like you have to refocus on like what value am I going to get out of this versus the effort that you put in it."* Part of being mindful about how she invests her time and efforts given her lofty goals and responsibilities in tech is to act with intentionality which takes a degree of self-awareness and understanding what she wants and why out of her career.

4.2.2.3 Non-Values Driven

In this sub-section I use narrative style quotes to illuminate aspects of the mindsets of three of the participants who were not necessarily value-led in their career decisions. For Hannah, Yana and Tonya, values were important but their talents and or needs motivated their career decisions.

Hannah

While making an initial career choice can be daunting, some participants were aware that their initial career interests might shift. In preparation for such a shift, participants approached their first jobs with the awareness that it was primarily a means of gaining real-world experience, helping them figure out if they made a good choice. For example, Hannah was unclear about what to do with her interests. *"I realized that I didn't know what I wanted to do, specifically, I had like a bunch of ideas."* Unsure, Hannah made her first career decisions from a security perspective, where landing any job in her desired field was the desired outcome. For Hannah, the awareness of being unsure made her first job more of an experiential position as opposed to some permanent life decision. She used her first job in tech to explore whether her first career choice was indeed a good fit - *"Thankfully, my first internship really solidified my career in working with the web."* As evidence of being self-directed, Hannah also pursued a masters—in part for personal value for higher education but also as an *"avenue to my next opportunity."* Hannah reflects on the unforeseeable benefit of her graduate engineering degree. *"The main way my master's has helped me so far is with being an instructor at a local college, which was a future I didn't see for myself when I started my Masters. I'm really happy I did it."* Through reflection on her decision to pursue a graduate degree to increase her salary and career opportunities, Hannah discovers how sometimes decisions can lead to unanticipated outcomes. This realization makes her even more inclined to continue reflecting on which decisions actual yield outcomes that lead to her own satisfaction.

Yana

Yana is another participant who benefited from self-awareness. For Yana, knowing that she had a change in interests helped her take on opportunities to pivot her software engineering career trajectory to the field of data science. In discussing how she made the switch to a different niche area in tech, Yana explains that the *"[company] actually reached out to me. … my experience in [program language] as it relates to data visualization led the recruiter my way. At the same time, I was looking for an opportunity to expand my skills …. And grow professionally."* Keen on shifting motivations, Yana was able to confidently take a chance when a new opportunity presented itself.

Tonya

For Tonya, the introduction to engineering happened late in her primary education. *"I don't have the typical STEM story because I did not discover engineering until I was preparing for college my senior year in high school. I did not take computer science or coding courses, chemistry or physics until I was in college."* Though she did not have a strong science or computing foundation before college, self-awareness of her learning preferences helped Tonya figure out where she was struggling, and her self-directed nature allowed her to work her way to the knowledge and level of understanding she needed to excel in her engineering studies. While it was not easy, she talks about how comparison to her seemingly better prepared peers made learning engineering more difficult when she felt isolated in her academic struggles. *"I was always in peer groups where everyone made it seem like complex concepts [e.g., non-linear optimization] were never hard for them and that they just came to them with ease!"* She talks about not even knowing how to begin solving certain problems*, "I was completely confused at how to even approach trying to solve them."* She caught a break when a *"kind upper classman showed me how to … visualize [the] types of optimization problems and equations using … modeling software."* As a *"visual learner … that helped me to see the problem space in 2-dimensions and 3-dimensions … so seeing the problem helped me to start to build a mental model of patterns and ways to recognize the solution options I had at my disposal."* This experience taught Tonya that she should never feel alone in her confusion and that there is *"no singular experience when it comes to learning."* In reflecting on that undergraduate learning experience her takeaway for herself and others is to *"not let the pride of others' insecurities allow you to question your capability."*

I have described the thematic codes that emerged and represent the types of psychological components that participants relied-on to enact their career goals. I use the next section 4.3 to describe themes related to participants persistence in tech and describe the role it plays in supporting other themes like identity and impact linked to participants continued decisions to stay.

4.3: Persistence in the tech industry

In section 4.3, I present findings to RQ3: *why do black women persist in the tech industry?* I describe the other prominent themes and sub-themes related to participants persistence in tech. Specifically, I present findings related to participants mindsets (e.g., adaptability), identity, and strategies for career opportunities and development that Black women have resorted to when faced with obstacles or career challenges. I discuss the traits participants attribute to their persistence while using narrative style quotes to highlight how participants differentially express these themes. I focus the remainder of section 4.3 on the themes related to participants persistence in tech, I briefly define how themes were coded before detailing narratives of participants lived experiences.

4.3.1 Career authenticity

Here I use narrative quotes from participants to illustrate the sub-themes related to identity. Identity is considered as beliefs one has related to their self-concept. Specifically, I describe career authenticity, or the idea of showing up at work as your full self, not compartmentalizing.

Once Jocelyn identified her career interests and values, part of her persistence in the industry came from prioritizing those interests and values upfront and the willingness to walk away from organizations that did not honor prioritize her preferred skill set. *"I make sure all of my priorities align and find balance between my work and free time. I carve out the time to make sure important things fit."* She works toward making her dreams a reality by *"align[ing] [her] priorities"* yet still *"reserve[ing] time for self-care"* so that she has the energy and focus to continue to *"chase her dreams"* while simultaneously *"uplift[ing] her community."* For Jocelyn part of remaining authentic in her dual-career as a business owner and technologist was the decision not to accept outside funding. *"[My] company raised most of its money by selling products. That worked for us. There's definitely opportunity that comes with raising capital, but you also have to consider other people's perspectives, opinions, and concerns. Those perspectives might not always align with your company vision."* Wanting to remain in charge of her own vision, Jocelyn elected to bootstrap her company, which has *"given [her] the maximum amount of independence"* in deciding the direction and growth of her *"successful business."*

Unicorn_Magic is another person whose ultimate view of career is one of a 'calling'. In discussing her biggest career project to-date, she stated, *"One of the greatest milestones on my journey thus far has been finding my purpose. This happened when two of the things I loved became one; my passion for my community and technology."* Passionate about her inner-city, and surrounding

neighborhoods with at-risk youth one of Unicorn Magic's biggest successes to date is the culmination of two of her passions combining. Her involvement in STEM advocacy for the youth in her community combined with her expertise in technology led to an opportunity to lead the implementation of smart technology for the entire city, a huge undertaking as well as milestone in Unicorn Magic's career journey.

Candance had an early interest in engineering and conceptualizes her own engineering identity as a young girl, aged 6, who wanted to develop ideas, write, design, create and tell stories using technology as a tool to solve problems for humans. For Candace, beyond identity, her career is a calling, as she considers herself an engineer for life. *"I will spend my whole life trying to figure out problems and make them better."* She has persisted despite people underestimating, pre-judging and assuming who she is and what she can and will do. *"You have to really know yourself, what you value, what inspires you. IF you have that you can do anything."*

On deciding whether to accept a company's offer, Yasmine is intentional about staying in work environments that support her authentically. *"I think that you have to remember that you need to always consider yourself first. That is how companies operate."* Her top considerations once she gets an offer is: 1) how valuable the job is to your career development, 2) whether it is fiscally acceptable, and 3) team/company character. In terms of career development, Yasmine originally pursued a master's degree in information systems to help advance her in her career. While her graduate degree *"opens a lot of doors and often makes the job easier in terms of relating to the engineering team,"* her experience has taught her that she does not need an advanced degree to be *"a great [product manager]."*

Tiara is passionate about coding and combines that passion with her desire to inspire more women and historically marginalized groups to not only choose careers in tech but to thrive in those careers. She has found gainful employment at a non-profit organization that directly speaks to her passions. *"It is the organization's responsibility to help students feed their spark and light their paths. It is our mission to not only change the landscape of the tech industry, but to help other women and diverse populations change the trajectory of their lives."* Having a job that serves both her personal interest in tech but also directly allows her to have an impact on the tech industry broadly means that she can divest all her energy into showing up as her full self at work. *"I am a software developer, an educator, and an ideator.* Whether she is writing code to *"manage apartment maintenance requests" or* developing software as a curriculum *"to be a resource"* that helps others find their *"path in tech … [her] passion is building software to solve all types of problems."* The work she does, the organization she works for and the environment of support she has found enable her to show up in her career authentically: *"I can't begin*

to express how proud I am of the team I work on. There is absolutely NOTHING you can throw our way that we can't handle together." Tiara is one the fortunate ones to have such positive experiences and impact while thriving in her tech career and makes it part of her personal mission to pay it forward for the next generation.

4.3.2 Networking– Increasing Career Opportunities and Development

Some participants used the tech communities they engaged with outside of work to 1) find new opportunities, become more visible, and get recruited or 2) take advantage of access to mentors getting advice on professional topics like salary negotiation. Below I provide examples of different ways participants used their communities to access career opportunities.

While trying to break into tech as a self-taught engineer, Yvonne was slightly discouraged when she kept getting rejection letters. She decided to try a *"different method of getting [her] foot in the door of one of [those] tech companies."* Aware that sometimes *"it's not what you know but who you know that gets you in"* and with nothing to lose she decided to approach the job search with more intentionality and purpose. Joining an online community, Yvonne began engaging with professionals and got insider information on where she could go (e.g., engage online) to increase her chances of landing a job in tech. Later, Yvonne's self-directness and an open mindset for learning made her inclined to have high engagement with topics and people, which is conducive to building networks, especially extra-organizational networks. For example, in pursuing her passion and seeking to further her own career development as a *"front end engineer,"* Yvonne engaged in online communities to troubleshoot issues with plugins. Engaging with newer software and running into issues that *"the community they don't have a lot of answers for"* led her "*directly to the people that work [there]." "I go to the person that built it. … and getting answers straight from the source … they're really open to reaching out to you and like helping."* She also talks about going on other online tech communities (e.g., Twitter, Spectrum) and the importance of using 'hashtags' to label the questions you post to the community because *"so many people will reach out to you and like try to help you solve the issue."* Yvonne stayed in her first position for almost two years before moving on as a software engineer at the very company she was using to build her expertise.

Yana relied on support and resources in her extra organizational networks to find and apply for interesting career opportunities. *"I would say that the extra-organizational network is true, my outside network is definitely stronger than my organizational network."* She attributes the establishment of her network base to relationships nurtured from time spent consulting and interacting with customers and

colleagues over the years. Of course, her work history and sheer skill also keeps her in good standing with former bosses. For Yana, it was such a relationship with a former employer, that led her to most recent role in tech. She highlights the importance of advocacy and champions in the workplace. Briefly, advocacy is taken on by more senior colleagues and managers that essentially vouch for opportunities that a person should be considered for. She explains how a former boss, reached out to her about apply for a position that led to her most current role to-date. Speaking of her former boss *"he gave me the opportunity"*

Hannah really settled into the niche of cloud developer using her skills to primarily *"[fix] bugs, [do] features; [as] a software developer" "What I ended up realizing is there was a need,"* among other developers to *"show the .NET devs the interesting ways that they can use the cloud".* Once Hannah realized her passion for speaking and advocating the cloud services, she began attending conferences where she explained software and digital products in depth to other people in Tech. It was her actions to pursue her passions that spurred her career advancement. In fact, *"Public speaking led me to this role at [Tech giant company]. My future manager was present for my talk and reached out a few days afterward."* She landed a job that sent her around the world to speak at conferences, host workshops, write and edit content and had responsibilities to meet with product teams for continuous feedback from developers.

As mentioned in 4.2.1.3 Yasmine is one of the participants whose value of community was not directly related to their role in tech. Yet their extensive community engagement was still leveraged as extra-organizational networking and indirectly contributes to their ability to secure jobs and find opportunities in tech. *"My last 3 jobs were [all less than a year]. I haven't had an issue moving from one role to another, but I also do lots of things to get me name out in my community and build trust with potential employers"* Once they got their 'foot in the door,' Yasmine works in and around their community to build their network, character witnesses and reputation. Yasmine works extensively with non-profits in and around the communities they consider themselves a part of (e.g., African American, LGBTQ+). Yasmine volunteers their time to help grow and scale their support and resources to reach more individuals. Yasmine brands themselves as a social change evangelist and discusses their non-profit work when asked 'What's something you've done that you're really proud of?'. They do this advocacy and volunteer work concurrent with building their experience and expertise as a product manager. *"I began speaking around the city, and eventually I was invited to speak around the country. I then turned those speaking gigs into a dream opportunity at [Tech Giant], which has led to the journey of a lifetime."* The combination of Yasmine's self-directness and ability to land jobs that align with their interests keep

them working in technology. They recommend that others looking to make transitions into tech or pivot their roles once in tech to 1) read books and blogs, 2) get certifications and 3) attend local Meetups in their area for the topic or subject they desire to work in.

Tonya acknowledges her *"STEM sheroes, black women in engineering, especially in graduate level programs, have such a bond and such a sisterhood that I look up to all my peers, former mentors/mentees and friends."* These fellow women created a space of camaraderie that serve as a source of inspiration and support for participants. Similarly, Jocelyn seeks to build relationships with others like herself and *"typically get[s] involved in employee resource groups and mentoring programs at work"* to gain awareness and find other *"black women in tech so we can support each other down the road."* She also mentions the utility in attending *"conferences for niche communities as well as more established professional communities"* where she can connect with and *"gravitate towards people with similar backgrounds and lifestyles as [her]self."*

4.3.3 Adaptable, growth mindset

Here I present the narratives of participants to demonstrate the sub-theme of adaptability. Briefly, adaptability is defined as the ability to rapidly learn new skills and behaviors in dynamic, new, or challenging environments. A sub-theme that often showed up alongside adaptability is open-mindedness regarding career opportunities. Open-mindedness is a willingness to consider unanticipated and new experiences.

Hannah is a good example of how being open minded with respect to career opportunities can result in unanticipated career outcomes. For example: As a nervous flier, who anticipated "*flying a few times out of the year" for work to see her family actually "[found] a job where I travel more than I ever expected"* As someone with a growth mindset, Hannah is invested in further developing her technical skills. Fortunately, Hannah works at an organization with supportive upper management and colleagues regarding career development. As a self-directed learner, Hannah thrives in an environment that supports her autonomy. *"[Company name] has a lot of learning resources. They have an internal site you can go to. You say, I want to do machine learning and they have all these resources, all these things set up for you to do that."* For Hannah, the combination of having a job that aligns with her interests, values and knowing that *"there are people here that want to help you invest in your career and are invested in your career."* Are key factors that contribute to her continued persistence in the tech industry.

A key component that was important to Yana's persistence in her tech career, is her aptitude to learn as a key skill that enables her to adapt and *"come up to speed"* on new skills needed for jobs that she applied to but *"did not have the resume [for]." […] "I wasn't learning the way that I wanted to, I wasn't accelerating at the rate that I should"* at the current job and contemplated leaving a cushy position [for an] environment for accelerated growth in big data. Though opportunity driven, Yana is not one to leave a job or organization without intentionality and planning. Specifically, when pursuant of a new career opportunity she: 1) trains her replacement, 2) sets her team and or project up for success, and 3) approaches the new position with a *"go in fresh"* attitude and an *"openness to new experiences."* As someone with a mastery orientation, Yana found that *"the best form of freedom as a developer"* is *"having the flexibility to innovate in a growing and changing field".* Yana identifies her aptitude to learn as a key skill that enables her to adapt and *"come up to speed"* on new skills needed for jobs that she applied to but "*did not have the resume [for]."*

Tonya relies on her faith, to pull her through in times of adversity. *"Faith is something eternal helps keep me focused when the temporal things go awry (as they tend to do)."* Tonya gains her fulfillment in life not from her STEM degrees or her identity as a woman of color but rather her faith helps her *"to finish any task or path, and not just to finish, but as we in my family like to say, to finish well."* To go along with her strong faith, Tonya also relies on her characteristic self-directness to solve challenges in her career path. *"I keep working until it's not a challenge anymore"* her advice to others is to *"give yourself a set amount of time before you ask for help. If you don't, you'll either waste a day or ask too soon before you have a chance to learn on your own."* She advocates for giving yourself room to grow cognitively by *"put[ting] up boundaries that let you spin your wheels yourself."* Additionally, Tonya finds that working toward your passions *"will give you extra motivation when it's difficult. No one is going to be there late at night when things get challenging. You have to have the passion within yourself."* As Tonya continues to learn and apply her expertise, the mastery orientation with which she approaches her career work lead her in her success. She continues to be employable and makes unique contributions to her field because of her ability to *"push [herself] to learn new things and figure out how a solution or a skill set in one domain can be applied to another domain in an innovative way."* Related her adaptability Tonya articulated that, to an extent, it depends on work life integrity, or the balance between *"home and work, that allows me to handle more or less ambiguity."* For example, if a family medical condition required her to make more money, she may be inclined to accept a project with a team or leader she would not normally work with; however, *"all things being equal, it is the people for me, I have to have a good team!"*

In reflecting on her career trajectory, and pattern she says, *"no one's career looks like my career."* In addition to being non-traditional in a non-linear pattern, Candance is refereeing to the proverbial glass ceiling she has come up against. *"I've been in every department. If I were white, I would have been promoted; I would be VP."* She points to her organizations limited perceptions of her aptitude and capability: *"They don't see me as a world changer, as a shifter, a mover."* In effect, their talent criteria are preventing them from 'seeing' her "*visionary excellence".* Instead of gambling her time and wait for her organization to see her fullest potential, Candance chooses to bet on herself, saying that she makes time *"when I am not a work…to work on those bigger things."* Yvonne's persistence through her *"non-traditional route into tech (Self Taught)"* is due in part to her self-directedness, which is evident in her mastery-oriented mindset. For example, Yvonne viewed her first job as a stepping-stone in developing her expertise *"even though my learning journey wasn't over I had finally found a company that believed in me and wanted to help me grow!"* In her spare time, Yvonne also does research on front end engineering software *"to build learning resources that [she] is working on."* Yvonne's self-directness when it comes to her career development has led to career opportunities.

As she engages with her online network to advance her software development skills Tiara also gets closer to making a shift in her career. As she shares on her personal *website "… the next pivot of my career from educating others as my primary contribution to helping people solve problems by delivering software in an agile environment."* It appears that Tiara is experiencing or has experienced a shift from her early career value which was striving to *"inspire and train the next cohort of software developers,"* to now wanting to use her tech skills to develop unique software solutions for clients. A key component of participants adaptability was in their ability to strategizes career moves the put them in alignment with their new-found career interest, environments, and or responsibilities.

In the tech industry, *"your expertise, ability to lead, and [being the] best 'fit' for this role conveniently come into question when navigating opportunities in the tech space."* Specifically, Unicorn Magic draws attention to how being a woman of color puts you in a small box when it comes to how society *"'defines' your potential."* On strategies for navigating such hurdles Unicorn Magic suggests a shift in mindset. *"These are the hurdles that we face; they can become real tangible roadblocks to our dreams and aspirations. I've learned that others' perception of you is ultimately not your problem, but it can be when you give it power."* Her mastery orientation is evident in this quote, where her success is based on her own effort and not hinging on others.

4.4 Chapter Summary

To succinctly summarize the findings for Chapter 4, I provide a brief overview of each of the answers to each research question. In reference to RQ 1, participants entered tech through a multitude of pathways. There were those who entered tech through traditional means, as in directly from university, as well as participants who switched into tech from non-tech industries. Participants also entered tech through non-traditional means, specifically being self-taught in terms of software engineering. Additionally, participants entered careers in tech with a variety of early career anchors that influenced their decision-making including but not limited to values-, needs-, and talent-based motives. Lastly, the first job search strategy used by participants to gain full-time employment in tech ranged between using existing networks to strategically find job opportunities or secure job offers, necessity-based job search strategies – applying multiple organizations and roles without much intentionality other than basic qualifications. Lastly, some participants were recruited to their first jobs, given the visibility they have in their respective areas of expertise.

Related to RQ2, participants differed in their personal values and the extent to which they were value led. However, there was a shared theme of community as it relates to participants values. Community functioned as a personal value or career motivation for participants. For some participants, the community value was rooted in a belief of giving back where statements like *"I did not get here on my own"* reverberated throughout the participants' re-telling of the career journeys. Some of the community value and importance of engaging with local communities came from participants own familial background and first-hand knowledge of their parents and grandparent's involvement in civil rights activism and community organizing. Having grown up volunteering, it was a natural practice for participants to see where they could apply their technical skills as a resource or solution to others. Community was also a key source of extra-organizational networking for professional development and opportunities among participants. In addition to the different ways the value of community motivated how participants structured their lives as it relates to work-community relationship, the reliance on communities for networking was attributed to their continued persistence and ability to find satisfaction in their tech careers.

Finally, in reference to RQ 3, participants have persisted in tech largely due to their authentic identities in tech and the environments they were able to find or cultivate that they could bring their whole selves to. A key part of this was their adaptability mindset coupled with their ability to engage in extra-organizational networks and continually finding and securing career opportunities. An important note to the reader related to the societal context during data analysis. The findings that emerged from participants career data were being analyzed concurrently with the several critical societal events in the United States

(e.g., global pandemic COVID-19 spurring an economic shut-down, Black Lives Matter and socio-political protests, and a presidential election year) (Drakulich, Wozniak, Hagan, & Johnson, 2020). Unemployment in America was at record low during the 2020 year, and an increasing number of jobs switched either temporarily or permanently to a remote work format (Coibion, Gorodnichenko, & Weber, 2020; Kawohl & Nordt, 2020; Şahin, Tasci, & Yan, 2020). Given the direct stress these events had on work opportunities and workplace settings collectively, make the findings related to participants persistence in the third and final research question, timely and important. Also, it is noteworthy to mention that all 10 of the participants were still actively working in the tech industry at the time of data analysis and concurrent with the critical societal events in the United States in Fall 2020.

In the next chapter I support my findings on Black women's engineering career experiences by situating them in existing literature and outline the contributions my work makes to extend the field of career theory and engineering education research methods.

Chapter 5. Discussion

The overarching question that guided this qualitative multi-case study was to understand: **How the career concepts of Black women engineers influence their career mobility strategies in the tech workforce?** I use the term 'career mobility strategies' to describe Black women's decision-making patterns once in the workforce, and career concepts to label insights into the underlying motivations behind the decision(s). In the final chapter, I situate the study findings in existing literature and discuss the implications of my dissertation. I begin by discussing the findings that were shared across participants as it relates to literature on Black women in the workplace, in STEM, and entrepreneurship. I also discuss the findings considering conversations with Black women in the broader tech community, where I use narrative style quotes from the member checking sessions to illustrate support or emphasize study findings. Next, I discuss emergent themes related to career literature and highlight how my findings advance career theory. Lastly, I situate findings of participants mobility both physical and psychological as it relates to traversing the boundaries between engineering and technology as a professional. In addition to situating the findings in relevant literature, I also support the findings with cascading narratives from member checking with participants and other Black women in the tech community. I end the chapter with implications for research and practice.

5.1 Black Women in Tech

This section will focus on the findings that participants shared, such as the value of community, identity and being self-aware. I begin by discussing the feedback from other Black women in the tech community to emphasize the transferability of the study findings to describe the career experiences of Black women in tech broadly. I also cover the career perspective on remaining mobile in the physical (e.g., organization hopping) and/or psychological (e.g., adaptability) aspects. Though each of the participants had different journeys on how they arrived to and through tech, each is its own story of a sense of identity and values. Agnostic of the order in which it came about, whether they found their sense of self first and identified their values later, or simultaneously, each was able to combine their sense of identity and values to guide their careers and achieve subject career success. The women in my sample differed by and large in the degree to which they were able to adapt, their willingness to be flexible, and in their preference to cross organizational and geographic boundaries, subject matter, technical work different than their interests. This multi-level analysis that follows individuals across organizations, industries, occupations, and geographical boundaries is important for understanding the multiple factors that can influences a person's career decisions (Crowley-Henry, Benson, & Al Ariss, 2019). Likewise,

these findings can be used to inform changes to career management practices that better support Black women's continued participation in tech.

As previous mentioned, I use cascading narratives from Black women in the broader tech community (e.g., outside of my participants) to discuss how the study findings resonated with other Black women in the tech community. I solicited feedback from Black women in the tech community to further evaluate how the case summaries resonated with others in the workforce (i.e., to check for pragmatic validity)**.** I spoke to a total of five women during community member checking. Each of these women said that parts of the findings either resonated with their journey or another Black woman's journey that they knew. The responses from these community members also implied that most Black women tend to be either values driven or physically and psychologically adaptable, though the extent to which both qualities appear varies greatly. Essentially, the community member checking validates that the study findings accurately portray the variation in Black women's career concepts but do not precisely capture every Black woman's career outlook. As I alluded in section 3.7 on the study limitations, the sampling frame used for this study appears to be biased toward illuminating Black women who possessed both career concepts of being strongly values driven and highly adaptable when most Black women tend to either be strongly values driven or highly adaptable.

When I discussed the findings related to Black women's career mobility with other members of the tech community, their reactions and feedback can be summarized into three key takeaways: (1) Black women have a tendency to be risk-averse when it comes to their careers, at least early on (2) Black women rely on others to determine their career advancement and would benefit if they took charge of their own career trajectory; and (3) Black women benefit from allies in the workplace. Related to the first take away, one Black woman in tech had the following to say: *"White men jump around a lot sooner, we want more of a security blanket."* They also said that Black women grapple with *"knowing [whether] they are making the right move which keeps them in roles, or at companies where growth in skills or opportunity for advancement are lacking."* In part, taking risks like leaving your employer for the potential of better opportunities at another company requires a degree of self-awareness and clarity on personal goals(Lin, 2015). Briscoe, Hall, and DeMuth (2006)warn that individuals lacking awareness or priority of values can run into the issue of not knowing what criteria to make decisions on and can end up stuck in careers or jobs that stifle their growth. For participants in the study, pursuing jobs informed by their underlying career motivations brought career satisfaction because it helped them establish a foundation for their career expectations. These motivations served as criteria with which to evaluate whether a job/organization is ultimately supporting, aligned with or subverting their core values and or interests (Schein, 1990, 1996).

Related to the second takeaway, on the topic of career advancement, Black women in tech had the following to say: *"if YOU don't move, you don't move,"* emphasizing the agency, or self-management required for Black women to advance (Arthur, 2014). Another member of the Black women in tech community added that it was imperative as Black women to possess *"a willingness and openness to leave an organization, if or when [an] opportunity to advance is not presented or mutually beneficial."* This sentiment of self-reliance for career advancement is evidence of the well documented paradigm the shift in employees' psychological contracts from being dependent on organizations and structure for promotion to a more transactional exchange between organizations and employees in a give and take dynamic(Briscoe & Finkelstein, 2009; Greenhaus, Callanan, & DiRenzo, 2008). These new attitudes toward work are well-suited to the 21st century workplace trends and have been attributed to the protean career concepts sometimes referred to as self-management, proactive career behavior, as well as individual career management (Chin & Rasdi, 2014).

Though a willingness and capability of skills is needed to effectively self-direct or advance in your career, member checking also illuminated parts of the career that are dependent on relationships with others. Relating to the third takeaway, it was evident that to an extent Black women will have to rely on their ability to form relationships with allies at work in order to continue their upward career ambitions (Aydoğmuş, 2019; Goleman & Boyatzis, 2017). For example, one Black woman defines sponsorship and why it is so important for Black women to find if they want to advance: *"'[I] put my reputation on the line for this person to move up.' The terms sponsor and advocate are often used interchangeably but sponsorship requires an additional commitment and requires a level of comfort that is built through relationship."* The majority white male leadership common in the workplace stresses the "*importan[ce] to have allies that are not black to help, to get you up there"* (Randel, Galvin, Gibson, & Batts, 2021). While sponsorship between white men and Black women is not a new concept, the heightened awareness of the importance of sponsorship for career advancement especially among historically underrepresented ethnic groups has led to more formal applications of how to implement this sub-type of mentoring dynamic across relationships across race (Randel et al., 2021).

5.1.1 Shared Values

Despite the differences that exist among Black women in tech broadly, there were shared values related to attitudes about identity and the importance of community that were echoed in the data as well as the feedback received on the overall study findings. The participants in this study had varied underlying early career motivations that changed with their tech career experience but appeared to stabilize over time. While it is not uncommon for individuals to possess multiple underlying career motivations, there tends to be a hierarchy or primary motivating factor for everyone (Crowley-Henry et al., 2019; Prince,

1979; Schein, 1990, 1996). To this point, the primary career anchors of the participants showed a noticeable shift away from the need-based (e.g., security/stability career anchor) in their early careers to a more value-based anchor (e.g., service/dedication to a cause) and or need-based and talent based career motivations once they acquired more experience. According to Schein (1990, 1996), employees generally tend to discover their career anchors around age thirty (e.g., after they have worked for several years). Though age was not included in screening criteria for participation, the sample contains participants in the range of late twenties to early forties and the study findings support the temporal nature of career anchors commensurate with experience.

In addition to the discovery of their own career motivations beyond the common need-based motives in the early career, once participants became established in their careers, they demonstrated an enactment of their value for community. They specifically sought to leverage their technical expertise and knowledge as a community resource. Agnostic of the value, some individuals choose value-led careers or put another way they use their personal values as a guide for their career decisions (Briscoe & Hall, 2006). The benefit of being value-led in your career is that your value(s) can serve as an anchor in terms of moral guidance as well as identity (Briscoe & Hall, 2006). In contrast, being value led in your career can result in unfulfillment if a person is unable to adapt to an organization or find an organization in which their values can be expressed and nurtured (Briscoe & Hall, 2006).

Lack of career advancement, or being stuck in junior-level positions, is a problem that the literature has identified for Black women (Burlew & Johnson, 1992; Combs, 2003; Nauta et al., 1998; Oh & Lewis, 2011; Ong et al., 2011; Randel et al., 2021). My study findings indicate that changes in career anchors can lead to changes in mobility strategies. An individual who is primarily value led but who does not search for jobs at organizations that support their values may result in dissatisfaction with their place of employment. Similarly, not being aware of your career anchor could also cause unfavorable career outcomes if the criteria for you base your decisions off are not ones that motivate you. Additionally, the finding of a shared value for community in relation to participants professional roles, could be a cultural by-product of the racial backgrounds and culture of participants. According to Smit and Cronje (2002:258), Africans also tend to relate to an Afrocentric value system that bases psychological feelings of career success on a preference for quality of life and a common vision that rewards communal effort. The Afrocentric culture also relates to the values of a “feminine” culture that emphasizes nurturance, the commonality of all people, vision, values, and efforts, as well as a concern for relationships, and the living environment.

5.1.2 Identity: Career Authenticity, Self as a Brand, Community Impact

In relation to their identity, several participants and other Black women in tech discussed viewing themselves as a brand, where they actively elected to represent and advocate on behalf of their respective communities (Causon*, 2004; Schenk & Holman, 1980). It was important to these women that the needs and values of their community aligned with, or at least, were not in opposition with an organizational mission. In the findings, networks showed up as a career strategy and showed up in relation to identity. Specifically, participants and Black women in tech from the second round of member checking described themselves as a brand and spoke of networking from a marketing perspective. The participants also developed a more salient sense of self along their career journeys with experience. Using various naming schemes, the individuals identified the technical parts of themselves as engineers, technical evangelists, champions of diversity, etc. over time. Once these individuals had developed a career-oriented sense of self (Manai & Holmlund, 2015; Schenk & Holman, 1980), the tendency was to be more intentional on vetting the alignment of company missions, values, and culture fit with personal values during the job search process (Kuron & Taggar, 2016; Taggar & Kuron, 2016). This vetting of company morals in the job search process included participants identifying current and former employees of potential employers and reaching out to them online. In thinking of oneself professionally as a brand, these women were intentional about making sure that their work life contributed directly to, or at least honored, the vision and values that these women had prioritized for their lives. Leading with their values meant they could bring they whole selves to work and enact tech careers with authenticity(M. S. Ross, Huff, & Godwin, 2021). With the self as a brand, the women in this study found a way to combine their group identity (e.g., community) with their professional lives for the betterment of both their community as well as their own subjective career success and satisfaction. Multiple participants discussed a change in mindset to 'self as a brand' as key to helping them not only navigate the job search process but attract opportunities as well.

Additionally, having successfully obtained careers in tech, participants readily recognized the potential in sharing their stories and acting as gatekeepers to STEM resources for others. One thing that has continued to motivate, inspire, and encourage these women to remain in tech despite the hardships they are facing or have faced is the evidence of the impact their efforts have on their communities. I use the term "community" to represent both the actual geographic communities that these women come from (e.g., program offerings in their own neighborhood) as well as communities in the abstract that represent support that was important to these women attaining their careers and livelihoods. Some communities that held value for the participants were fellow women of color, first-generation students, organizations that fight for homeless, LGBTQ+, etc.). Having impact in these coveted community spaces has been a continued source of inspiration and benchmark for future career success. As on participant stated, *"I want my potential for impact to rise."* Individuals who are attracted to the value-led cause career anchor

usually value fair pay and recognition for their contributions and the opportunity to move into positions that allow them to have more influence and freedom in pursuing their important values of serving the world or the community (Schein 1996). Because of their ambitions for change, they also tend to be anxious to work in a field typical of the service industry (e.g., social work) that matches their values rather than their skills due to lowered average earning potential (Kniveton, 2004a, 2004b).

5.1.3. Self-Awareness

Careerist Schein (1992) argued that it is important to understand a person's career orientation (e.g., career anchor) because people use it to "evaluate organizational experience" (Schein, 1992). For example, someone with a needs-based career motivator (e.g., financial security) may generate criteria for success by which to measure themselves and consider, for example, their ability to pay bills as a benchmark for subjective career success. To briefly review participants career motivations, the findings support that participants used a mixture of value-based as well as talent- and needs-based motivators, in isolation or various combinations, to establish their career decision-making criteria. However, with experience, Black women come to use their values as a primary motivation in their career decision making.

Agnostic of the type of motivation, participants who were aware of their anchor would base their career decisions on criteria that aligned with their motivators to help scope the types of organizations they considered, determine when it was time to move on, and even the types of jobs they applied for (Aydoğmuş, 2019; Chin & Rasdi, 2014; Lin, 2015). As it relates to the theme of self-awareness, reflection, and career decision making as a process of self-discovery (Di Fabio & Saklofske, 2019; Goleman & Boyatzis, 2017), one community member reflected on her decision to leave her first Tech employer (e.g., Apple). She emphasized that it took her *"over a year"* of reflection and introspection to come to her decision. Having worked for the company for several years, this Black woman in tech echoes the importance of self-reflection when evaluating whether to leave a job and then how and when to do so. She stressed the *"importance of evaluating your work experience apart from the company or brand you work for, especially in deciding when to leave."* Using a popular euphemism for folks who work in tech, specifically in the Silicon Valley area, and a direct reference to her former employer, she talked about getting swept up in *"drink[ing] the apple juice,"* or rather having to intentionally shift away from the objective view of your employer and career: *"-Apple is a great company with a mission to empower users;"* to a subjective view where you ask: -*"how is the company empowering [me]?"*

The act of career self-development involves preparing yourself for opportunities and continuing to develop skills to stay abreast with the latest technology required to do your job well. However, this self-development may have less favorable outcomes without awareness of career orientations or clear

career goals, resulting in a) being overqualified and as a result, underpaid for jobs; or b) burnout and subsequent withdrawal from STEM career/field. It appears that the women in this study fall into their own category, or c) using the pursuit of new skills and certifications as networking opportunities to receive mentorship that supports switching into a new niche markets or organizations with better opportunities for advancement within the tech industry. When career development is approached this way, it can be leveraged to master the ability to adapt. While not all Black women subjected to underrepresentation and hypervisibility approach career development this way, those working in tech that do discover their career orientation and have clarity on their goals, become highly adaptable (Koen, Klehe, & Van Vianen, 2012; Koen, Klehe, Van Vianen, Zikic, & Nauta, 2010; McArdle et al., 2007). Considering the history of toxic STEM work environments for WOC, the ability to develop new skills for a job, and identify ample opportunities to network and build relationships (Combs, 2003; Ibarra, 1995; Obiomon et al., 2007) in the process may be advantageous and even necessary as a back-up plan(Koen et al., 2010; McArdle et al., 2007). The key for all participants for this developing this adaptability was the iterative practice of self-reflection, specifically as it relates to evaluating prior career experiences and future career expectations will seeking out opportunities for self-improvement. According to Schein (1992), external feedback and self-observation are said to aid in realizing one's own career anchors (Schein, 1992). The findings are filled with quotes highlighting participants self-reflection and mindset as they evaluate their work experiences in the tech industry. The codes of self-awareness and self-reflection are conceptually aligned with components of self-observation which are needed to discover one's own career anchor. Hypervisibility was a sub-theme that emerged from the analysis and appears connected to external feedback and self-awareness. All the participants were hyperaware of the lack of diversity in their respective departments, teams, or divisions within their respective employers.

5.2 Black women's career orientations

In this section, I situate participants career motivation(s) and career attitudes in current literature. I then match participants into empirically derived career architypes and discuss how accurate the predicted career characterization and challenges were from the perspective of participant member checking. I end this section with a discussion on the implications of the findings for career development.

5.2.1 Emergent Career Theory

Through completion of this study, I concluded that the CCF lacked the nuance necessary to accurately describe the career patterns of the 10 Black women in my study. Essentially, the deductive coding process resulted in all 10 participants displaying the same combinations of codes, where phases of their career history matched up with a combination of either spiral or transitory orientations on the

physical factors (e.g., direction, duration, frequency) but did not always align for the psychological factors (i.e., values, attitudes). Let us take Ashley's case for example, her switch from engineering industry to a technology start-up reflect a combination of both the spiral (e.g., changes in career field) and transitory (e.g., pursuing entrepreneurship) career concepts from the CCF. However, her first five years in engineering followed a somewhat linear career concept with promotion form intern to entry level and mid-level engineer roughly every two years. Simply analyzing the physical dimensions of careers provides partial context. In Ashley's case, an understanding of her career motives, specifically how a shift in her career values, and discovery of her value for her community (e.g., broadening participant in STEM for POC) help us understand why she left her exciting, challenging yet successful dream engineering job at company X. She left to purse her personal value of broadening participation of POC in tech. To-date she has remained CEO of her tech start-up which has steadily continued to grow the past ten years and counting.

A study by Kerno (2008) using Driver's CCF to analyze careers in engineering suggested that transitory and spiral career orientations were the new career concepts of the 21st century engineer. While the CCF framework appeared to correctly categorize participants' careers as non-linear and non-traditional, it was ambiguous to discern differences between cases. The career orientations, as presented in the CCF, lacked conceptual detail and precision to adequately describe the differences across cases with similar psychological factors and different physical patterns or vice versa. Essentially, the shortcoming of Drivers CCF was that it mapped well to the physical mobility patterns of certain phases of participant's lives but the associated psychological factors were not helpful in explaining career mobility.

The CCF was accurate for describing portions (e.g., one job transition) of participants' physical career histories and lends itself to the argument that career orientations are semi-permanent and may evolve with career experience, though theory supports that orientations generally hold stable after a certain point (Schein, 1992). My findings indicate changes in participants' underlying career motivations which support Schein's (1992) work and adaptations by Feldman and Bolino (1996) on stability and multiplicity of career anchors over time. Building on Schein's career anchor work, Feldman and Bolino (1996) determined that people generally have one to three career anchors that revolve around their needs, talents, and/or values, and that these anchors reflect components of their self-concept.

The narrative and autobiographical context of the dataset captures periods of transition in participants' career orientation(s). Participants' early-career decision making was oriented toward satisfying needs and talent-based career motivations and interests. Career experience and life events further shape these women's perceptions of engineering and computing work and expectations. The combination of participants experience, and the continued practice of reflection culminate in self-awareness for participants. This self-awareness is directly linked to key decisions and points of departure

and re-direction in participants professional lives. Schein (1990, 1996) describes career anchors as a process in self-discovery that typically happens around age 30. Analyzing shifts in career anchors was paramount to making sense of participants' career patterns given the similarities among the physical dimensions of their careers.

5.2.1.1 Psychological Dimension

In career literature, career theories often focus on the physical dimension of career theory and not as much on the psychological dimensions. The findings presented herein make significant contributions on understanding the psychological dimensions of the non-traditional career patterns that are more common today. The themes identified related to being value-led, self-aware, and self-directed suggest that varying degrees protean career attitude were present in participants. The word protean makes reference to Greek mythology (e.g. Proteus) and is ascribed to a person who possess the ability to adapt (D. T. Hall, 1996). It is used to convey the shift in employee attitudes from relying on organizations to structure their professional development to self-reliance in regard to the ability to change and develop oneself. D. T. Hall (1996) defined individuals with protean career attitudes as having strong internal compass, resources, and capability in taking charge of their careers. For people with a protean career outlook, they themselves as opposed to the organization they work for, are more inclined to set an agenda and determine benchmarks for their own career success (D. T. Hall, 1996; Kerno, 2008). D. T. Hall (2004) argues that employees with protean career attitudes have adopted short term and transactional psychological contracts with their employers, a replacement of the former more traditional long-term psychological contracts that existed between employees and their employers. Where the new short-term psychological contracts stress the importance of continuous learning opportunities, autonomy, self-awareness and an overall pursuit of careers based on self-interests (Kerno, 2007; Maguire, 2002).

Kerno (2008) conducted a study on the careers of engineers from U.S.-based companies. He used a combination of attributes from Drivers (1982) CCF, specifically the spiral and transitory career concepts, to operationalize the protean career for his study. The emergence of protean career attitudes among participants helps to extend Halls (1996) theory of protean career attitudes to minority women. Additionally, the themes of adaptability as a psychological dimension of mobility along with the physical mobility dimensions (e.g., organizational tenure, role changes) were also suggestive of boundaryless career attitude (Briscoe et al., 2006). Boundaryless is characterized by a high psychological and/or physical mobility, where research on the latter is more dominant. The boundaryless career attitude is similar and related to the protean career but is its own distinct construct (Briscoe et al., 2006).

Briscoe et al. (2006) argued that protean and boundaryless attitudes carry an element of magnitude. Therefore, the question is not whether an individual is protean or not, or boundaryless or not.

Instead, the question is to what degree an individual is boundaryless and protean. The conceptual work on the protean and boundaryless career hybrids provided clarity and additional nuance to the debate on whether participants are value-led or physically and psychologically mobile in the absolute. My cross-case analysis suggests that varying degrees of both career attitudes (boundaryless and protean) are present in each case. Participants essentially differed in the extent to which they were "led" by their values and to which degree they were willing and able to utilize their networks for opportunities to break boundaries (e.g., physically leave an organization and/or psychologically adapt their skill set to a new niche area in tech).

5.2.1.2 Empirically Derived Career Archetypes

Having established measures for both the protean and boundaryless career attitudes, Briscoe, and Hall (2006) developed 8 combinations of theory driven and data-informed hybrid career archetypes to characterize the most common expressions of protean and boundaryless career attitudes. In attempts to adequately capture the ambiguity between cases, I ranked participants as either high or low with respect to how protean, or value led and self-directed, their careers were relative to others in the study. Similarly, participants were ranked relative to one another for their degree of boundarylessness (e.g., high, or low for both physical and psychological components of boundarylessness). In Table 14, I provide an overview of how participants mapped to the hybrid protean/boundaryless career archetypes.

Table 14. Participants Mapped to Career Archetypes adapted from Briscoe et al. (2006)

Case Names	Characteristics of Career Mobility by Archetype
Yana	**Wanderer** - reactive opportunity seeking, does not see organizational or geographical boundaries as a barrier
Hannah	**Transformist** - highly self-directed with clear sense of priorities for their career contributions. Physically boundaryless (e.g., travel for work)
Yvonne	**Idealist** - strongly values-driven should aim to find career situation that allows them to be idealistic but does not require them to be flexible (e.g., ivory tower for academics)
Tiara	**Organizational Woman** - strong ability for self-directed career management, not interested in physical mobility, works well across psychological boundaries
Tonya, Ashley	**Solid Citizen** - strongly protean, looks for a career that matches strong values, need for autonomy, satisfy learning drive through work.
Yasmine	**Hired Hand** - emphasizes directing their career management activity, highly mobile and adaptive, looks for opportunity to take advantage of and reward their abilities
Jocelyn, Candace, Unicorn Magic	**Protean Career Architect** - both psychologically and physically boundaryless, on a quest to define meaning and success; deciding where to apply their ability (e.g., "where can I have greatest impact")

Briscoe & Hall (2006) hypothesized characteristics of career mobility as well as the challenges that employees and employers would experience according to the career archetypes. Using participants

career data, I ranked them relative to each other, according to the different dimensions of boundaryless and protean components to classify them by the theoretically derived career archetypes. During member checking, participants were presented with the hybrid archetype that their data matched into. They were specifically asked to comment on the accuracy of the archetype to their lived experience. I have included reaction quotes from select participants collected during member checking in Table 15. The feedback from participants during member check was useful to collect evidence that builds support for the use of Briscoe & Hall (2006) empirically derived career archetypes for understanding career trends of Black women in the engineering and computing workforce and ways in which the findings can inform career development that supports the subjective career success of Black women in these STEM professions. For the next section, I focus the discussion on the relationship between tech and engineering as it relates to participants' career mobility.

Table 15. Member Checking Feedback Reactions to Archetypes

Feedback on Archetypes	Illustrative Quotes
Insightful	*"This would have been helpful, years ago" – Unicorn Magic*
Aspirational	*"I mean I am not all of those things all of the time, but I would say I aspire to be" - Tonya*
Confirmatory	*"Yes, transformational, absolutely that is me, I wish my boss could see this" - Candace*
	"I mean I don't believe in palm reading, but YUP! 'wanderer' that's me!" - Yana

5.2.2 Missing Voices

Specifically, there were two other archetypes of Black women in engineering my sampling frame failed to capture. Members spoke about the ***Change Agent*** or the Black women who possess the more traditional career pattern and stays at one organization her entire career with a personal mission to drive change. Members spoke up memories of being interns and employees at companies with Black women, usually older and more senior in position, such as these, and noted the types of farewell speeches the accompanied their retirement. For example, 'when I started at the company, I was the only Black woman, and now as I look out into the audience, I see so many more'. The *Change Agent* archetype appeared to have a career motivation that supports staying at an organization out of loyalty to all the Black women coming behind them. The participants spoke of change agents with a degree of reverence *"let's not forget about the ones who are in it for the long haul"* with some comparing their own career motivations to the change agents as *"fighting a different battle, but the same war."*

The other Black women career archetype that was missing from the findings according to member checks was the *loyalist*. ***Loyalists,*** represented the Black woman who stays at an organization or takes on a role and stays despite the fit or alignment out of loyalty to the person who *"took a chance on me."* Participants spoke of loyalist's archetypes from the perspective of both a former self and other Black women they knew. In both scenarios they alluded to an internal battle of loyalty to others over loyalty to self and concluded that these loyalists, despite their well-meaning intent, sometimes *"stay too long,"* to the detriment of their career potential (e.g., lack of advancement) and or burnout.

Both archetypes (e.g., change agent and loyalist) appear to be related in that they represent somebody who stays, albeit for different reasons. The Black women in this study were similar in their high degree of career mobility, relatively speaking.

5.3. Career Mobility Across the Engineering Technology Partnership

As first mentioned in chapter 2, at every level of workers and industries, there is a dynamic relationship between engineering and technology. The study findings support that Black women traverse between computing and engineering roles within tech, rather fluidly. Analysis of participants changes and progression in occupational roles reveals that business, as its own field, is also intimately related to engineering and technology. Given the close working relationship between engineering, business, and technology, some participants job titles similarly indicate mobility across professional roles in tech that mirror this boundaryless trajectory among these sub-fields within and even across tech organizations. The best example of the relationship between business, technology, and engineering is the career progression of participants like Candace who worked her way up from senior business analyst to technical engineer, product manager, to sales engineer and then made a pivot to senor product marketing manager within the same company.

5.3.1 Job Search Strategy

In this study it was clear that the level of adaptability in combination with chosen mobility strategies, were the biggest determinants of participants career outcomes. This finding of mobility strategies impact career outcomes is well supported in the literature. While literature on vocations has emphasized job search intensity (i.e., the frequency with which people search for a job) as a measure of job search behavior, as the focus of scholarly investigation over the past two decades (Blau 1994; Saks and Ashforth 1999; Werbel 2000; Creed et al. 2009; Koen et al. 2013; Da Motta Veiga and Turban 2014; Lim et al. 2016). Job search strategy, as a measure of job search behavior is more relevant and has greater on the actual job search outcomes (Koen et al. 2010; Taggar and Kuron 2016; Koen et al. 2016). The challenge of finding opportunities conducive to a given skill set required participants to be aware and intentional with respect to their job search strategies. I use the remainder of this section to discuss the

navigational strategies (e.g., mobility strategies) participants used and how this aided in their ability to readily move across different niche areas within the tech landscape.

In discussion of findings for RQ1 (section 4.1), I elaborated on the types of search strategies that were employed by participants upon entering the tech industry, linking strategies and career orientations when possible. In this section, I focus the discussion on participants' early-career orientations, which are aligned with the work of Schein (1990, 1996) and adaptations by Feldman and Bolino (1996). Feldman and Bolino (1996, 2000). While early career anchors were diverse, the most common anchor was needs-based, specifically related to security and stability. Though most participants career anchors shifted with experience, they largely fell into two categories, where some participants chose tech because it aligned with their interests, STEM identity, or value of challenging work. The other participants initially chose tech for the financial security jobs in that field typically provide.

The job search strategies that emerged from participants early career efforts to enter employment in the tech industry align with strategies found in extant literature (Crossley & Highhouse, 2005; Koen et al., 2010; Stevens & Turban, 2001). For the women who had already developed strong tech-related interests (e.g., robotics, gaming, sci-fi) at a young age and or had identities in STEM rooted in their formal STEM education backgrounds, the first jobs in tech were approached from an opportunistic mindset. For participants with an opportunistic approach, it was common to either leverage their networks or resources to access and explore job opportunities conducive to their existing skill sets (e.g., internships converted to full-time, headhunters through online engagement). Research supports the finding of networking as a distinct job search behavior, akin to the strategies used by participants in this study (Forret, 2018; Van Hoye, Van Hooft, & Lievens, 2009). The participant who adopted an opportunistic approach either new people already at the job they would be working for or had a skill set or specific niche area (e.g., back end development) in which they wanted to grow their experiences. In the literature, job seekers following exploratory search strategy (ESS), have some idea about the types of job they want, but are open to opportunities that might present themselves. Therefore, job seekers following ESS besides applying for the jobs they are interested in, explore various alternatives across different industries too (Stevens & Turban, 2001).

Some participants who exhibited a needs-based early career anchor took a necessity-based approach to the job search strategy; that is, in needing a job, these women applied to as many jobs as possible with the intention of accepting that first full-time position that was offered. According to Stevens and Turban (2001), job seekers following haphazard search strategy (HSS) have no or little idea about the type of job they want and apply a trial and error approach to their job search. The participants who adopted this necessity approach or HSS, often, needed more experience (e.g., due to lack of formal degree or lack of networks) and used the first job to gain experience and refine their interests and niche area. The

necessity based approach rarely yielded favorable job outcomes for participants and was almost always followed by another more intentional job search attempt. For example, Yvonne initially took a necessity-based approach to her tech job search and submitted hundreds of applications but was not successful in landing a full-time offer. When she revisited the job search process, Yvonne began looking for another job but this time, she was intentional with her job strategy. She only applied for positions at five companies based on skills and research on the company mission and values. Researchers Stevens and Turban (2001) describe this intentional approach as job seekers using focused search strategy (FSS). With FSS, people focus is on a small number of potential employers thereby limiting the job search to the job they are interested in and/or industries they want to work for (Bonaccio, Gauvin, & Reeve, 2014; Koen et al., 2010; Stevens & Turban, 2001; Taggar & Kuron, 2016).

5.3.2 Job Search Outcomes

The occupational tenure of participants who made decisions based on opportunities and intentionality, at least for the first job, was longer than that of those who took a necessity approach to job searching. The literature suggested that FSS is positively linked to all the job search outcomes while use of HSS was negatively related to the number of job offers, re-employment quality, and satisfaction with the job and the job search process. Empirical research, although limited, have shown that the strategies used by the job seekers significantly influences the success and outcomes of job search (Crossley and Highhouse 2005; Koen et al. 2010; Bonaccio et al. 2014; Taggar and Kuron 2016; Koen et al. 2016). The findings in my study support less satisfaction among participants with outcomes when necessity-based or HSS are used. The job tenure of participants who accepted their first tech job from a necessity approach was shorter, and their secondary job search was often more intentional and targeted as a result. Specifically, when Hannah was attempting to find a job out of state because she wanted to relocate, she ended up landing a software engineering job in another region of the US but had not factored in the cost of living with her new salary and found her student debt and bills increasing. When she rejoined the job search market, she was very intentional about her strategy and even took initiative to educate herself on how to negotiate a better salary based on her needs.

5.4 Implications & Future Work

Based on the feedback from participants related to the accuracy of the hybrid career archetypes, I discuss implications for how this work can be leveraged to broaden the participation of Black women working in engineering and computing roles in tech. I focus specifically on implications of this work for Black women including those currently in and those aspiring to work in tech. I also address how these findings can be leveraged for stakeholders, namely academics and industry leaders to continue to support the interests and career development of Black women with engineering and computing interests. I provide

a high-level overview of these implications in Table 16 but discuss each target audience in their own respective sub-sections within this chapter.

Table 16. Implications for Career Development by Archetype

Hybrid Career Archetype	Stakeholder(s) – Industry/Academia	Stakeholder(s) – Individual
Wanderer	Help develop self-direction, establish whether this is good fit after this is achieved	Continuously find new interests to pursue
Transformist	Find challenges to push out of comfort zone and help build competency and adaptability skills, establish whether fit good after this is achieved.	Find stable opportunities that match curiosity and build adaptability
Idealist	Find challenges to push out of comfort zone and help build adaptability skills—in terms of mindset and working across boundaries.	Finding organizations that match values, curiosity but do not require mobility
Organizational Woman	Do not be seduced by performance ability. Increase self-awareness to make leader of high performer.	Find stable organizations where competence can be demonstrated
Solid Citizen	Help develop self-direction, establish whether fit good after this is achieved.	Continue to find new interests to explore
Hired Hand	Convert talented, reactive person into effective, self-aware leader with a sense of priorities	Identify and respond to best opportunities for providing services across boundaries
Protean Career Architect	Provide stages on which to shine, learn, engage. Temper if need.	Leverage capability into meaningful impact.

5.4.1 Next Generation – Aspiring Black women engineers

In reference to Black women currently navigating the tech industry and those who aspire to follow in their footsteps, the study findings strongly support that if you identify your values in life and prioritize those in your career you will experience subjective career success. An unspoken takeaway from participants and other Black women from the member checking was to not lose your individuality to the career while trying to be like everyone else. Rather find a way to either bring your best self to your work embracing your values (e.g., of community, or family, or beauty, etc.) or find an organizational environment or network where you can express those other salient parts of your identity. Also, it was instrumental for some of the participants to realize that they possessed the resources, knowledge, and skills to create some of those environments and organizations for themselves and other, but it required degree of self-awareness and confidence to "bet on myself" and take a risk to invest in a goal or dream even if others around have doubted you. This study has highlighted the strength in finding communities of support and verified that they do indeed exist although they may not readily by one in the same with a

corporate tech employer. Essentially, the takeaway is that sometimes the best opportunities for career growth and satisfaction may be found in extra-organizational networks and for those few like Ashley or Tiara who seemingly have found all in one deal, the best opportunity may just be you yourself.

The good news is that there is so much room for improvement to broaden the participation of Black women and other POC in tech, and most Black women have the implicit knowledge and understanding of the barriers and challenges to technical, political, and even cultural roadblocks to make the necessary changes. In one way or another each of the participants focused their career efforts on having a positive impact by becoming a resource and leveraging their own time, skills, and abilities without sacrificing their own self-care and personal values in the process.

5.4.1.1 Analytical Generalizations

As stated earlier in Section 3.3 in Table 5, the theoretical propositions can be useful in providing analytical generalizations now that the study is complete (Yin, 2015). Going in order from (a-h) I now revisit each of the propositions to elaborate on how they can aid in transferring the implications of the study findings to other situations (e.g., contexts, samples) (Yin, 2015).

> Proposition (a): career related decisions are intentional; but do not always align with desired outcomes

This statement best captures the experiences or sentiments of Black women who sometimes stay and are perhaps less mobile in their engineering careers. During member checking, participants identified scenarios or women for whom the study findings may not be as relevant and highlighted the intentional misalignment between career decisions for personal gain and actual career outcomes. For example, the loyalist makes career decisions based on a commitment to another individual for well-intended reasons but does so at the expense of achieving their own career goals. This mindset was brought up in reference to a former self or an aspect of identity that individuals once possessed and typically learned from in hindsight (Ibarra, 2005).

> Proposition (b): personal values guide career decisions for some Black women

While most people hold personal values, not every person is inclined to base their career decisions on their person values. This assertion proved to be true for my participants. Relative to one another, certain cases proved to be strongly values driven. In situations where their career trajectory or organization of

employment misaligned or no longer supported those values these individuals were inclined to leave for career opportunities that were in direct alignment with their values. For participants like Ashley, Candace, and Unicorn Magic, this strongly value based career orientation resulted in entrepreneurial pursuits, as they decided to create their own organizations to control how their values were aligned and enacted through their career work. For participants like Yana, who valued community but relied on talent to dictate her career decisions, her expression of the personal value came about through her free time and volunteer work with organizations in her community.

> Proposition (c): Black women make career decisions based on a variety of influences (e.g., community, family, personal)

In answering research question 2, I had to first examine the host of reasons and factors that lead to the participants' intermittent career decisions throughout their career journeys. During analysis, it became apparent that proposition (c) holds true for this study. There were a variety of need, talent and value based decisions that oftentimes dictated participants' career decisions. No participant made every career decision for the same set of reasons, as life often presents mitigating circumstances and unexpected surprises that warrant new considerations. For example, Tonya who is normally talent driven in her career decisions described how her career criteria was ultimately dependent on the status quo of the other important things in her life. *"If everything is fine at home (e.g.,, family, health and financially) then I prioritize working with a good team at work. However, if something is off at home (e.g., say someone is really sick and medical expenses are piling up) I may forsake my ideal team dynamic for a role that pays more (i.e., make decisions based on needs)."* However, over the history of their careers participants career decision making tended to form a pattern and that was helpful to assess and analyze the larger picture of what was ultimately driving their career decisions.

> Proposition (d): Black women have motivating interest not necessarily shared by the organizations for which they work

Regarding retention of diversity, it is very important to understand the types of career anchors that individuals possess so that proper reward systems and incentives can be tailored to help individuals find satisfaction as well as providing opportunities to be successful. Having achieved her dream goal of becoming an engineer for her favorite company, Ashley was quite satisfied with the engineering work she was doing and the skills she was learning. However, the community outreach goals and incentives provided by her organization missed the mark on the type of impact she cared to have with the people in

her own community. *"My mission was bigger than their mission."* Proposition (d) really highlights how lack in a critical area (e.g.,, social impact for an individual who is strongly values driven in their career orientation) can lead to employee turnover. Given that Ashely is strongly values driven in her career decision making this misalignment was enough to make her leave, another individual, say with a different career orientation (need-based) may have stayed and done so with complete career satisfaction and much success. Understanding the underlying cause of a person's career motivations or their career decision making anchor can be key to retaining them satisfactorily in their career field. Ashley had been getting promoted and receiving awards and recognition for her work in the traditional engineering industry, from an objective perspective she was very successful as an engineer in industry, yet she still left her organization to do the same type of work that served a broader mission that aligned directly with her personal values.

> Proposition (e): Black women will offset negative workplace experiences and unsatisfactory work roles by engaging in tangential activities outside of work (e.g., community building, non-profit work, entrepreneurship)

Though I entered the study assuming that proposition (e) was true, the data did not fully support that Black women offset negative workplace experiences with activities outside of work. Essentially, participants generally placed a high valued on their self-care and negative experiences (e.g., workplace discrimination, or toxic work environments) that were juxtaposed to their well-being was often grounds for leaving an organization. However, participants did experience work roles that did not fully satisfy all their needs, and in those instances, participants were willing to look for that satisfaction by engaging in tangential activities outside of work (e.g., community building, non-profit work, etc.). For some individual's careers are a means to an end, they do not constitute the end all be all. This outlook on career means that careers may afford some of the monetary or financial stability they require to maintain a certain lifestyle or invest in certain passions. Not everyone looks to their career as a source of fulfillment or needs their career to satisfy all aspects of their lives. Some Black women have minimum criteria to which they hold their job (e.g.,, pays me well, I get to do what I enjoy, I can sleep with a clear conscience at night) but do not necessarily have expectations for satisfaction (i.e., personal or career development wise) from their place of employment and look to outside communities or extra-organizational engagement for that type of support. Based on this I would augment proposition (e) to state the following:

> Proposition (e'): Black women will offset unsatisfactory work roles by engaging in tangential activities outside of work (e.g., community building, non-profit work, entrepreneurship)

Proposition (f): Black women in engineering are aware (either subconsciously or consciously) of gender and racial bias they may face upon entering the workforce.

Each one of the participants referenced their identity as a Black woman as a point of difference once in the workplace. Some participants noted this awareness in other settings as well (i.e., in college – particularly STEM education) others more so when it came to professional experiences compared to their White counterparts (i.e.,, working in a startup context and financial and familial capital or lack thereof). The hypervisibility was often met with a degree of self-reflection and reassurance regarding personal ability, capability, past achievements, and career goal orientation through the uttering of bible verses, or personal mottos and mantras that acknowledged the reality of the situation (e.g.,, I am the only who looks like me) but celebrated the uniqueness of their accomplishments and qualifications to do the work and be deserving of the rewards.

Proposition (g): Repeated barriers to advancement, workplace challenges, and increased stereotype threat due to hypervisibility and lack of role models contribute to burnout and Black women's decisions to leave [add the industry]

Due to the extensive networks and networking skills that these participants had coupled with their boundaryless mindset in terms of their career capabilities and their intentional self-reflection in response to hypervisibility, there were not repeated barriers to advancement. In coming up against resistance, participants did not repeat the same tactics, they sought out new advice and new opportunities (e.g.,, different job search strategy, learning a new skill) to improve or at the very least change the outcomes. They were all rather self-directed in their careers in this aspect. While hypervisibility was a common occurrence among all participants at some point, their shared value of community enabled each of them to find mentors or colleagues in a community of practice to supplement their career development. For example, Hannah credits her local tech meet up with other WOC in tech for teaching her how to negotiate for a higher salary while on the job search. Granted these communities of practice were all intentionally sought out by the participants and existed almost exclusively separate from participants organization of employment (e.g.,, extra-organizational networks) However, without the initiative to seek out these communities and do the networking participants may have experienced burnout and opted to leave the engineering profession.

Proposition (h): Work experiences, including barriers and opportunities for advancement, differ in tech depending on organizational context (e.g.,, smaller tech start-ups, tech entrepreneurship, established tech corporations)

Based on the data analyzed, I would emphasize that the differing organizational contexts provide different opportunities for visibility in the tech industry that can enhance your chances of being recruited for better opportunities. The tech industry is always looking for great talent. For example, Tonya's participation in a tech start-up while in graduate school got her noticed by a tech giant that readily recruited her to work for them. Likewise, Hannah and Yana's expertise and desires for self-improvement to enhance their skills for their current roles (working for companies that promote self-directed career management) made them visible in the public eye (e.g.,, Hannah using public speaking to force herself out of a comfort zone when learning new tech skills) rendering them experts and easier to find from the standpoint of recruiters looking for specialized skills. Yvonne got picked up by a small start-up as a software engineer, who initially had struggled to find a full-time opportunity. The smaller company was attracted to her eagerness to learn and though she was hired as a software engineer due to the smaller nature of the company she got a chance to explore additional roles and responsibilities in tech. This initial opportunity at a start-up enabled Yvonne to find her technical niche area all because a smaller tech company was willing to take a chance on her even though she was self-taught.

5.4.2 Academic – Engineering Education

The findings related to Black women's entry into STEM support the importance of more advanced math, science, and computer science courses to be available in K-12 (Burrelli, 2009; Clark Blickenstaff*, 2005; Granovskiy, 2018; Malcom & Malcom, 2011; Morton & Parsons, 2018; Wicklein, 2006) if the goal to broaden the participation of girls and women in engineering is to be realized. While the participants in this study all had diverse STEM education backgrounds, I found it compelling that none of the Black women in this study had early-exposure to STEM in a formal education setting. For example, while Candace, Jocelyn, and Hannah all have stories of early-exposure to tech in their pre-teen years, they attribute the support for their early interest and exposure to programming, robotics, or hardware tinkering to family and other role-models within their sphere of influence. Even Unicorn Magic, who was interested in gaming as a youth, found little support at her high school due to a lack of resources. For Unicorn Magic and Ashley, their parents played an important role in making them aware of opportunities in STEM and enabling their access to technology. For other participants like Tiara, who had not considered engineering until arriving at college, and even Tonya who only began to consider a career

in STEM until a year after she finished her undergraduate degree, the opportunities for better preparation were not pursued because these women simply had not considered or did not know it was an option for them.

My findings also indicate a strong support for early exposure to STEM interests/careers for young Black girls in conjunction with career self-efficacy (Hackett & Betz, 1981; Malicky, 2003). Specifically, the findings in this study support a relationship between external validation related to engineering or computing work, career self-efficacy and career identity. For the women who had early mentors and exposure to STEM (e.g., Hannah, Candace, Yana), their STEM career identities appeared to be more salient earlier in their careers. The earlier the exposure, then arguably the more experiences an individual has to collect evidence to perform a conduct self-judgement. The data supports that low-self efficacy, especially in relation to imposter syndrome cannot be remedied with adequate external evidence or validation of success. Rather, while all participants eventually develop a salient career identity in STEM, the journey to discover career identities as well as conquering the "crippling doubts" that are cast by *imposter syndrome* can cast dissatisfaction on a persons' outlook. Essentially, the participants who had early exposure and or role models in STEM prior to their STEM college experience, had higher career self-efficacy or held strong and optimistic beliefs regarding their own potential for career success at the outset of their career journeys

The findings will contribute to understanding how Black women transition into tech, and, once in, how they choose to participate in the tech workforce. The findings will provide insight into the national patterns of high turnover, short organizational tenure (i.e., less than 5 years), and low representation at advanced career stages of Black women who have worked in an engineering-related capacity within the technology workforce.]

5.4.3 Industry – Talent Acquisition, Human Resources and Engineering Mangers

Given that participants fit within the hybrid protean-boundaryless career archetypes, I end with a discussion on changes that organizations and human resource management can strive for to become more protean and or boundaryless, or at the least to accommodate career attitudes of workers who possess these career attitudes.

5.4.3.1 Supporting the Protean Worker

Organizations that can demonstrate an ability to recognize the need and reshape how work is completed, as well as how careers unfold for individuals will remain competitive in attracting and retaining employees with a protean career outlook (Cabrera, 2009). The global pandemic that resulted from the

novel coronavirus infections provides an excellent example of a scenario where organizations have had to reshape how they monitor and expect employees to complete work and contribute to the organizational mission. As Cabrera (2009) highlights, organizations that can give their employees more flexibility in how they complete their work, by shifting the focus away from emphasizing face time (e.g., physically being at work) and focus more on results, redistribute control back to employees. Fueling a sense of empowerment and supporting employees desire for career self-management (Aydoğmuş, 2019; Cabrera, 2009). Furthermore, employee emotional intelligence as well as their subjective career success are positively mediated by protean attitudes and feelings of empowerment (Aydoğmuş, 2019; Goleman & Boyatzis, 2017). Additionally, human resource professionals should begin providing career attitude trainings and help to establish work environments that empower employees which fosters self-awareness and self-management and are key component to fostering emotional intelligence (Aydogmus, 2019; Goleman & Boyatzis, 2017). Implementing policies that support the development of employee's emotional intelligence (e.g., mandating minimum usage requirements of vacation and paid time off) will have positive impacts on subject career success (Aydogmus, 2019; Goleman & Boyatzis, 2017). Lastly, workers with protean career attitudes tend to have greater perceptions of their external employability than their current occupation (e.g., internal employability) (Lin, 2015). However, work by Lin (2015) supports that goal setting fully mediates the effect of the protean career attitude on perceptions of internal employability. Essentially, human resource managers can influence employees perceived employability using appropriate strategies toward learning-goal orientations to increase motivation and improve employer-employee relationships that contribute to organizational success (Lin, 2015). Likewise, continuous goal setting and learning would become increasingly important to help employees deal with changes at work (Lin, 2015).

5.4.3.2 Supporting the Boundaryless Worker

From a talent management perspective, career development is commonly considered a key component yet the two topics (e.g. talent management and career development) remain largely disconnected in human resource management literature (Crowley-Henry et al., 2019). Briefly, the objectives for talent management are to attract, develop and retain key employees (Collings & Mellahi, 2009; Crowley-Henry et al., 2019). Crowley-Henry et al., (2019) argue that talent management will be more successful when organizational leaders have a greater understanding of the individual career orientations of their employees, and of their underlying motivations for following these career paths (Crowley-Henry et al., 2019). Based on the efforts of researchers to theoretically develop talent management practices through a career lens that encompasses both traditional (e.g., linear) and boundaryless career orientations, I present the propositions Crowley-Henry et al., (2019) proposed that align with the findings from this study to improve human resources management of employees possessing

non-traditional career orientations. Mainly talent management should leverage both the formal and informal external network of its employees in order to facilitate the expectations of prospective and existing talent (Crowley-Henry et al., 2019). Organizations should also be proactive in providing career plans, opportunities and supports for women and other minority groups that are underrepresented at leadership levels with the organization (Crowley-Henry et al., 2019). Lastly, organization-level career development plans, opportunities and supports should be tailored for high potential employees that demonstrate boundaryless (e.g. lateral, vertical, or international mobility preferences) as well as traditional (e.g. vertical mobility) career orientations to reduce turn-over intentions and improve performance development of talent within the organization (Crowley-Henry et al., 2019).

5.4.4 Future Research

In this sub-section I discuss the limitations of my sampling, highlighting the unique qualities of my participants as a subset of workers with a hybrid career orientation of both boundaryless and protean career attitudes. I also address what future researchers may need to consider to capture more "typical Black women." I end with a discussion on importance of using anti-deficit methodology for future works that examine the educational backgrounds and career trajectories of Black people as a key step in continuing the effort to broaden participation in engineering.

5.4.4.1 Sampling Limitations

Although the career journeys in all 10 cases were uniquely different, there were obvious shared experiences among the cases. These shared experiences were made apparent by the fact that all 10 women mapped to the same career types during the deductive round of coding using the CCF framework, which was a combination of spiral and transitory orientations. Likewise, in the inductive coding round, the same themes emerged for all 10 participants, although there were slight differences in how the themes were expressed among cases. Taken together, these similarities suggest that the sample is potentially biased toward individuals that share a unique hybrid career orientation. References to career literature based on the shared themes does support that all 10 cases represent variations of a combination of both the boundaryless and protean career attitudes. As such, the findings from this study are potentially biased toward individuals possessing features of both boundaryless and protean career attitudes. Although subsequent member checking with other Black women in Tech outside of the study sample suggests that individuals possessing either boundaryless or protean career attitudes do find partial relation to some of the themes expressed in this study, the findings in their entirety will not necessarily resonate or characterize individual Black women's' tech career experiences fully. The goal of the study was not to characterize each type of Black woman's career experience. Rather, the goal was to disaggregate the

monolith and even in finding a sample of similarly career minded Black women: the 10 of them accounted for 7 unique hybrid career orientations. Each hybrid orientation has its own career characterization and unique set of anticipated career challenges and opportunities for support in overcoming those challenges. Taken together this information provides a starting foundation to reimagine how human resource practices can support a broader spectrum of engineers who have different views on what participating in the profession looks like.

In relation to the use of social media artifacts as a secondary data set for future research, I mention a few considerations. Given that 82% of the U.S. population has some form of social networking profile (Tankovska, 2021), it is assumed that data exists online for most individuals that can be informative toward understanding their lived experiences. Granted not all that data is available for public viewing and not all of it relates to professional career experiences. I recommend that future research on this topic or interest in replicating this methodological approach use a combination of existing and primary data to perhaps identify Black women in Tech who are not as "visible" online and use a hybrid data approach to collect information to study the career experiences of more typical Black women in tech.

5.4.4.2 Anti-deficit Methodology

In keeping with an anti-deficit approach, certain personal details were omitted from the final stories in efforts to disrupt the often-ignored assets and foundational wealth that Black families create for their children when it comes to STEM education and later career success (Habig, Gupta, & Adams, 2021). In their work published in 2002, Solórzano and Yosso criticize how social scientists often tell stories that distort and silence the epistemologies of people of color under the guise of conducting objective research. As I alluded in the methods section, certain details were omitted to protect participant anonymity; this does not mean that these omitted events were not analyzed in context of each participant's lived experience. I just chose to omit stating these isolated facts as the user generated and secondary nature of the dataset provided a wealth of information in the form of storytelling, familial history, short biographies, workplace scenarios, and narratives from which I was able to draw my analysis.

This approach of centering on the lived experience of participants to the fullest extent possible is what Solórzano and Yosso (2002) would classify as the centrality of experiential knowledge, a key component of conducting critical race methodology. It is the supreme recognition that the data produced by these participants about their careers in tech is legitimate, appropriate, and critical to understanding their experiences and provides an example of conducting anti-deficit informed research. In Baldridge's (2017) critique of the deficit narratives of damage and struggle that prevail for Black youth in education he calls such narratives pathological and advocates for creating a discourse that affirms Black youth

within educational spaces to help broaden what we imagine is possible for their career trajectories. For this study anti-deficit research was used to highlight racialized, gendered and classist experiences as a source of strength to garner resourcefulness, innovation, and overall persistence on behalf of participants to envision and enact their careers as engineers.

5. 5 Chapter Summary

The findings provide insights to the multiple ways Black women engineers define and enact careers in the technology industry, as well as insights into the values and strategies undergirding their career decisions and career satisfaction. At minimum, these findings will function to normalize other ways of doing engineering and serve as a form of representation for aspiring engineers from marginalized backgrounds. At maximum, this work will be an impetus for broadening the career orientations that tech companies cater to. Potentially providing details on how to restructure aspects of recruitment, rewards and development opportunities for personnel based on multiple non-linear career orientations as opposed to more traditional (e.g., linear, and steady state) ones.

Though the participants in this study found and charted their own non-traditional pathways to and through tech, the importance of role models and representation is STEM broadly is not to be understated. How much sooner could some of these participants have come to lead with their values or start pursuing engineering or entrepreneurship if the information and awareness of opportunities to resources were more readily available, more visible. It is my personal mission to continue to elevate the voices and experiences of Black women pioneering their way through tech. Each of these women has an incredible tech journey and none of them had role models, just imagine what the next generation of Black women in engineering and computing could do if the missteps, and hindsight of these veteran trailblazers was made accessible and packaged in format that was prescriptive, educational, and insightful. If necessity is the mother of invention, then vision is the mother of innovation. These women have envisioned careers and lifestyles for themselves without much blueprint and a host of opposition, yet still managed to forge unique and diverse career paths to obtain success. With minimal encouragement, external support, and validation and lots of self-determination these women are impacting people, communities, and industries all over the world. In addition to operationalizing these findings to better support these women and their careers in tech, I look forward to utilizing this work to help other Black women and girls discover their pathway into tech sooner. Having mapped career trajectories, and background stories, as well as identified common career challenges I am confident these stories can serve as vicarious models of success for other Black women to follow. Using existing scales to discern the degree to which a person may be boundaryless or protean, I plan to construct a career self-development handbook for Black women interested in pursuing tech with a central focus on subjective career success and satisfaction.

References

Arnold, J. (2011). *Career concepts in the 21st century*.

Arthur, M. B. (2014). The boundaryless career at 20: where do we stand, and where can we go? *Career Development International*.

Aydoğmuş, C. (2019). Millennial knowledge workers: The roles of protean career attitudes and psychological empowerment on the relationship between emotional intelligence and subjective career success. *Career Development International, 24*(4), 297-314.

Bagnoli, A. (2009). Beyond the standard interview: the use of graphic elicitation and arts-based methods. *Qualitative Research, 9*(5), 547-570. doi:10.1177/1468794109343625

Baird, K. M., & Mitchell, T. (2014). Using feminist phenomenology to explore women's experiences of domestic violence in pregnancy. *British Journal of Midwifery, 22*(6), 418-426. doi:10.12968/bjom.2014.22.6.418

Baldridge, B. J. (2017). "It's like this Myth of the Supernegro": resisting narratives of damage and struggle in the neoliberal educational policy context. Race Ethnicity and Education, 20(6), 781-795.

Baruch, Y., Szűcs, N., & Gunz, H. (2015). Career studies in search of theory: the rise and rise of concepts. *Career Development International, 20*(1), 3-20. doi:10.1108/cdi-11-2013-0137

Bhatta, T. P. (2018). Case Study Research, Philosophical Position and Theory Building: A Methodological Discussion. *Dhaulagiri Journal of Sociology and Anthropology, 12*, 72-79.

BigCommerce. (2021). Ecommerce Marketing and Strategy: What is a trending topic and how can it be used in ecommerce. https://www.bigcommerce.com/ecommerce-answers/what-is-trending-topic-ecommerce/

Bonaccio, S., Gauvin, N., & Reeve, C. L. (2014). The experience of emotions during the job search and choice process among novice job seekers. *Journal of Career Development, 41*(3), 237-257.

Brinkmann, S., & Kvale, S. (2015). *Interviews: Learning the craft of qualitative research interviewing* (Vol. 3): Sage Thousand Oaks, CA.

Briscoe, J. P., & Finkelstein, L. M. (2009). The "new career" and organizational commitment. *Career Development International*.

Briscoe, J. P., Hall, D. T., & DeMuth, R. L. F. (2006). Protean and boundaryless careers: An empirical exploration. *Journal of Vocational Behavior, 69*(1), 30-47.

Brooks, C. J. (2012). *Identity and intersectionality for big city mayors: A phenomenological analysis of Black women.* (Doctor of Philosophy Dissertation), University of Nevada Las Vegas, Las Vegas, Nevada.

Brooks, J., McCluskey, S., Turley, E., & King, N. (2015). The utility of template analysis in qualitative psychology research. *Qualitative research in psychology, 12*(2), 202-222.

Brooks, S. D. (2017). The Song (Does Not) Remain the Same: Re-Envisioning Portraiture Methodology in Educational Research. *The Qualitative Report, 22*(8), 2231-2247.

Brousseau, K. R. (1990). Career dynamics in the baby boom and baby bust era. *Journal of Organizational Change Management, 3*(3), 46-58.

Brousseau, K. R., Driver, M. J., Eneroth, K., & Larson, R. (1996). Career pandemonium: Realigning organizations and individuals. *Academy of Management Perspectives, 10*(4), 52-66.

Brown, D. (2018). *Google Diversity Annual Report 2018*. Retrieved from Online - https://static.googleusercontent.com/media/diversity.google/en//static/pdf/Google_Diversity_annual_report_2018.pdf: https://static.googleusercontent.com/media/diversity.google/en//static/pdf/Google_Diversity_annual_report_2018.pdf

Brown, S. E. V., & Liu, S.-N. C. (2018). Intersectionally Insufficient: A Necessary Expansion of the Social-Structural Lens. *Industrial and Organizational Psychology, 11*(2), 296-301. doi:10.1017/iop.2018.18

Burlew, A. K., & Johnson, J. L. (1992). Role conflict and career advancement among African American women in nontraditional professions. *The Career Development Quarterly, 40*(4), 302-312.
Burrelli, J. (2009). *Women of color in STEM education and employment.* Paper presented at the Mini-Symposium on Women of Color in Science, Technology, Engineering, and Mathematics, Arlington, VA.
Burton, T. A. (2017). *The Lived Experience of Intersectionality Among African American Women with Breast Cancer.* University of San Diego,
Buzzanell, P. M., & Goldzwig, S. R. (1991). Linear and nonlinear career models: Metaphors, paradigms, and ideologies. *Management Communication Quarterly, 4*(4), 466-505.
Bynum, K. J., & Stordy, P. G. (2017). Factors Supporting the Leadership of Women of Color in Higher Education, Local Politics, and the Nonprofit Sector.
Cabrera, E. F. (2009). Protean organizations. *Career Development International*.
Carby, H. (2007). White woman listen! Black feminism and the boundaries of sisterhood. In *CCCS Selected Working Papers* (pp. 753-774): Routledge.
Causon*, J. (2004). The internal brand: successful cultural change and employee empowerment. *Journal of Change Management, 4*(4), 297-307.
Cech, E., Rubineau, B., Silbey, S., & Seron, C. (2011). Professional role confidence and gendered persistence in engineering. *American sociological review, 76*(5), 641-666.
Chin, W. S., & Rasdi, R. M. (2014). Protean career development: Exploring the individuals, organizational and job-related factors. *Asian Social Science, 10*(21), 203.
Chmillar, L. (2012). Multiple-Case Designs. In *Encyclopedia of Case Study Research*: Sage.
Clark Blickenstaff*, J. (2005). Women and science careers: leaky pipeline or gender filter? *Gender and education, 17*(4), 369-386.
Coibion, O., Gorodnichenko, Y., & Weber, M. (2020). *Labor markets during the COVID-19 crisis: A preliminary view* (0898-2937). Retrieved from
Collings, D. G., & Mellahi, K. (2009). Strategic talent management: A review and research agenda. *Human Resource Management Review, 19*(4), 304-313.
Collins, P. H. (1986). Learning from the outsider within: The sociological significance of Black feminist thought. *Social problems, 33*(6), s14-s32.
Combs, G. M. (2003). The duality of race and gender for managerial African American women: Implications of informal social networks on career advancement. *Human Resource Development Review, 2*(4), 385-405.
Cook, C., & Waters, M. (1998). The impact of organizational form on gendered labour markets in engineering and law. *The Sociological Review, 46*(2), 314-339.
Corbett, C., & Hill, C. (2015). *Solving the Equation: The Variables for Women's Success in Engineering and Computing*: ERIC.
Crawford, D. K. (2015). *Tailor-made: Meeting the unique needs of women of color STEM-SBS faculty through mentoring.* Paper presented at the Frontiers in Education Conference (FIE), 2015 IEEE.
Crenshaw, K. (1989). Demarginalizing the intersection of race and sex: A black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *u. Chi. Legal f.*, 139.
Crenshaw, K. (1990). Mapping the margins: Intersectionality, identity politics, and violence against women of color. *Stan. L. Rev., 43*, 1241.
Creswell, J. W. (2013). *Qualitative Inquiry and Research Design: Choosing among Five Approaches* (3rd ed.). Thousand Oaks, CA: Sage.
Crichton, S. (2012). Use of Digital Data. In Encyclopedia of Case Study Research (pp. 951-954): Sage.
Crichton, S., & Childs, E. (2016). Clipping and Coding Audio Files: A Research Method to Enable Participant Voice. *International Journal of Qualitative Methods, 4*(3), 40-49. doi:10.1177/160940690500400303
Crossley, C. D., & Highhouse, S. (2005). Relation of job search and choice process with subsequent satisfaction. *Journal of Economic Psychology, 26*(2), 255-268.

Crowley-Henry, M., Benson, E. T., & Al Ariss, A. (2019). Linking talent management to traditional and boundaryless career orientations: Research propositions and future directions. *European Management Review, 16*(1), 5-19.
Denzin, N. K., & Lincoln, Y. S. (2011). *The SAGE handbook of qualitative research*: Sage.
Derr, C. B. (1986). A Review: Novations: Strategies for Career Management. In: Academy of Management Briarcliff Manor, NY 10510.
Di Fabio, A., & Saklofske, D. H. (2019). Positive relational management for sustainable development: Beyond personality traits—The contribution of emotional intelligence. *Sustainability, 11*(2), 330.
digitalundivided. (2018). *ProjectDiane*. Retrieved from https://www.projectdiane.com/
Dorsen, J., Carlson, B., & Goodyear, L. (2006). Connecting informal STEM experiences to career choices: Identifying the pathway. *ITEST Learning Resource Center*.
Drakulich, K., Wozniak, K. H., Hagan, J., & Johnson, D. (2020). Race and policing in the 2016 presidential election: Black lives matter, the police, and dog whistle politics. *Criminology, 58*(2), 370-402.
Driver, M. J. (1982). Future Trends in Engineering Careers: A Career Concept Approach.
Driver, M. J. (1985). Demographic and societal factors affecting the linear career crisis. *Canadian Journal of Administrative Sciences/Revue Canadienne des Sciences de l'Administration, 2*(2), 245-263.
Driver, M. J., Coffey, R. E., & Bowen, D. E. (1987). *Where is Human Resources Management Going?: Six Models in Search of a Future*: University of Southern California, School of Business Administration.
Dugger Jr, W. E. (1993). The Relationship between Technology, Science, Engineering, and Mathematics.
Ebrahim, S., & Singh, S. (2017). An Understanding into the Dynamics Faced by Females as they Transition from the Corporate Sector into the Abyss of Entrepreneurship. *International Journal of Research, 1*.
Edwards, A. M. (2015). Breaking the Bamboo Ceiling: Career Strategies for Asians. *Career Planning and Adult Development Journal, 31*(1), 37.
Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review, 14*(4), 532-550.
Evetts, J. (1994). Women and career in engineering: continuity and change in the organisation. *Work, Employment and Society, 8*(1), 101-112.
Evetts, J. (2000). Analysing change in women's careers: Culture, structure and action dimensions. *Gender, Work & Organization, 7*(1), 57-67.
Express, A. (2018). *The State of Women-Owned Businesses Report*. Retrieved from https://about.americanexpress.com/files/doc_library/file/2018-state-of-women-owned-businesses-report.pdf
Falkenheim, J., Burke, A., Muhlberger, P., & Hale, K. (2017). *Women, Minorities, and Persons with Disabilities in Science and Engineering: Special Report* (NSF 17-310). Retrieved from Arlington, VA: www.nsf.gov/statistics/wmpd/
Feldman, D. C., & Bolino, M. C. (1996). Careers within careers: Reconceptualizing the nature of career anchors and their consequences. *Human Resource Management Review, 6*(2), 89-112.
Feldman, D. C., & Bolino, M. C. (2000). Career patterns of the setf-etnployed: career motivations and career outcomes. *Journal of Small Business Management, 38*(3), 53-68.
Fernandes, J., & Barbeiro, L. (2015). *Onenote: a digital tool for qualitative research*.
Flaherty, K. E., & Pappas, J. M. (2002). Using career stage theory to predict turnover intentions among salespeople. *Journal of Marketing Theory and Practice, 10*(3), 48-57.
Fletcher, T., Ross, M., Tolbert, D., Holly, J., Cardella, M., Godwin, A., & DeBoer, J. IGNOREDPOTENTIAL.
Forret, M. L. (2018). Networking as a job-search behavior and career management strategy. *The Oxford handbook of job loss and job search*, 275.

Fouad, N. A., Singh, R., Fitzpatrick, M. E., & Liu, J. P. (2011). Stemming the tide: Why women leave engineering. *University of Wisconsin-Milwaukee, Final report from NSF Award, 827553*.
Frehill, L. M. (2012). Gender and career outcomes of US engineers. *International Journal of Gender, Science and Technology, 4*(2), 148-166.
Funk, C., & Parker, K. (2018). *Diversity in the STEM Workforce Varies Widely Across Jobs*. Retrieved from https://www.pewsocialtrends.org/2018/01/09/diversity-in-the-stem-workforce-varies-widely-across-jobs/
Galloway, P. D. (2004). Innovation—Engineering a better engineer for today's workforce. *Leadership and Management in Engineering, 4*(4), 127-132.
Garrett, S. D. (2017). *A Grounded Theory Investigation of Tenured, Women of Color Faculty at Predominantly White, Public, Research Institutions in the Southeastern United States.* Clemson University,
Gee, B., & Peck, D. (2017). *The illusion of Asian success: scant progress for minorities in cracking the glass ceiling from 2007-2015.* Retrieved from
Gines, D. (2017). *Black women business startups*. Retrieved from Omaha, Nebraska: https://www.kansascityfed.org/community/smallbusiness/black-women-business-startups
Ginther, D. K., & Kahn, S. (2012). *Education and academic career outcomes for women of color in science and engineering.* Paper presented at the conference for the Committee on Women in Science, Engineering, and Medicine, Washington, DC.
Goleman, D., & Boyatzis, R. (2017). Emotional intelligence has 12 elements. Which do you need to work on. *Harvard Business Review, 84*(2), 1-5.
Google. (2014). Getting to work on diversity at Google. Retrieved from https://googleblog.blogspot.com/2014/05/getting-to-work-on-diversity-at-google.html
Granovskiy, B. (2018). Science, Technology, Engineering, and Mathematics (STEM) Education: An Overview. CRS Report R45223, Version 4. Updated. *Congressional Research Service*.
Greenhaus, J. H., Callanan, G. A., & DiRenzo, M. (2008). A boundaryless perspective on careers. *Handbook of organizational behavior, 1*, 277-299.
Grzywacz, J. G., & Butler, A. B. (2005). The impact of job characteristics on work-to-family facilitation: testing a theory and distinguishing a construct. *J Occup Health Psychol, 10*(2), 97-109. doi:10.1037/1076-8998.10.2.97
Gurin, P., & Epps, E. (1975). *Black consciousness, identity, and achievement: A study of students in historically Black colleges*: ERIC.
Guynn, J. (2018). Google says it will focus diversit efforts on black, hispanic women. Retrieved from https://www.usatoday.com/story/tech/2018/06/14/google-says-focus-diversity-efforts-black-hispanic-women/703003002/
Habig, B., Gupta, P. & Adams, J.D. (2017). Disrupting deficit narratives in informal science education: applying community cultural wealth theory to youth learning and engagement. *Cult Stud of Sci Educ.* https://doi.org/10.1007/s11422-020-10014-8
HackerLife. (2017). Software Engineers Tenure in San Francisco. Online Retrieved from https://hackerlife.co/blog/san-francisco-large-corporation-employee-tenure
Hackett, G., & Betz, N. E. (1981). A self-efficacy approach to the career development of women. *Journal of Vocational Behavior, 18*(3), 326-339.
Hall, D. T. (1996). Protean careers of the 21st century. *Academy of Management Perspectives, 10*(4), 8-16.
Hall, D. T. (2004). The protean career: A quarter-century journey. *Journal of Vocational Behavior, 65*(1), 1-13.
Hall, S. (2014). Cultural identity and diaspora. In *Diaspora and visual culture* (pp. 35-47): Routledge.
Hannon, K. (2018). Black women entreprenurs: The good and not so good news. Retrieved from Forbes.com website: https://www.forbes.com/sites/nextavenue/2018/09/09/black-women-entrepreneurs-the-good-and-not-so-good-news/#14ae2a4d6ffe
Hanson. (2012). In *Encyclopedia of Case Study Research* (Online ed., pp. 846-847): Sage.

Harrison, H., Birks, M., Franklin, R., & Mills, J. (2017). Case study research: Foundations and methodological orientations. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research, 18*(1).
Hedge, J. W., Borman, W. C., & Bourne, M. J. (2006). Designing a system for career development and advancement in the U.S. Navy. *Human Resource Management Review, 16*(3), 340-355. doi:10.1016/j.hrmr.2006.06.002
Herman, C., & Lewis, S. (2012). Entitled to a sustainable career? Motherhood in science, engineering, and technology. *Journal of Social Issues, 68*(4), 767-789.
Hewlett, S. A., Luce, C. B., Servon, L. J., Sherbin, L., Shiller, P., Sosnovich, E., & Sumberg, K. (2008). *The Athena factor: Reversing the brain drain in science, engineering, and technology*. Retrieved from
Hill, C., Corbett, C., & St Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*: ERIC.
Ibarra, H. (1995). Race, opportunity, and diversity of social circles in managerial networks. *Academy of management journal, 38*(3), 673-703.
Ibarra, H. (2005). *Identity transitions: Possible selves, liminality and the dynamics of career change* (Vol. 51). Fontainebleu Cedex, France: Insead.
Jackson, S. M., Hillard, A. L., & Schneider, T. R. (2014). Using implicit bias training to improve attitudes toward women in STEM. *Social Psychology of Education, 17*(3), 419-438.
James, G. (2017). Cul-de-sacs and Narrative Data Analysis–A Less Than Straightforward Journey. *The Qualitative Report, 22*(12), 3102-3117.
James, J. D. (2015). Linking African-Americans to the Workplace. *International Journal of Business and Social Science, 6*(2), 8.
Johri, A., & Olds, B. M. (2014). *Cambridge handbook of engineering education research*: Cambridge University Press.
Jordan-Zachery, J. S. (2007). Am I a black woman or a woman who is black? A few thoughts on the meaning of intersectionality. *Politics & Gender, 3*(2), 254-263.
Kaufman, H. G. (1974). Relationship of early work challenge to job performance, professional contributions, and competence of engineers. *Journal of Applied Psychology, 59*(3), 377.
Kawohl, W., & Nordt, C. (2020). COVID-19, unemployment, and suicide. *The Lancet Psychiatry, 7*(5), 389-390.
Kerno, S. (2007). Continual career change. *mechanical engineering, 129*(07), 30-33.
Kerno, S. (2008). Protean professionalism and career development. In *Career Development in Bioengineering and Biotechnology* (pp. 315-323): Springer.
King, N. (2012). Doing template analysis. In G. Symon & C. Cassell (Eds.), Qualitative Organizational Research: Core Methods and Current Challenges (pp. 426-450). London: Sage.
King, N., & Brooks, J. M. (2016a). Philosophical Issues When Using Template Analysis In *Template analysis for business and management students* (pp. 13-23): Sage.
King, N., & Brooks, J. M. (2016b). The Use of Template Analysis in Published Research: The Careers Literature as an Exemplar In *Template analysis for business and management students* (pp. 73-84): Sage.
King, N., & Brooks, J. M. (2017). *Template Analysis for Business and Management Students*.
Kniveton, B. H. (2004a). The influences and motivations on which students base their choice of career. *Research in education, 72*(1), 47-59.
Kniveton, B. H. (2004b). Managerial career anchors in a changing business environment. *Journal of European industrial training*.
Koen, J., Klehe, U.-C., & Van Vianen, A. E. (2012). Training career adaptability to facilitate a successful school-to-work transition. *Journal of Vocational Behavior, 81*(3), 395-408.
Koen, J., Klehe, U.-C., Van Vianen, A. E., Zikic, J., & Nauta, A. (2010). Job-search strategies and reemployment quality: The impact of career adaptability. *Journal of Vocational Behavior, 77*(1), 126-139.

Kuron, L. K., & Taggar, S. (2016). *Investigating Job Search Clarity: A Motivational and Self-Regulatory Perspective.* Paper presented at the Academy of Management Proceedings.
Lacy, M. (2017). Just tell me what I need to know reflexivity and positionality statements. Retrieved from https://www.marvettelacy.com/blog/just-tell-me-what-i-need-to-know-reflexivity-and-positionality-statements
Larsson, R., & Driver, M. J. (1993). *Career disintegration in mergers and acquisitions*: School of Economics and Management, Lund University.
Lawrence-Lightfoot, S. (2005). Reflections on portraiture: A dialogue between art and science. *Qualitative inquiry, 11*(1), 3-15.
Lazarova, M., & Taylor, S. (2009). Boundaryless careers, social capital, and knowledge management: Implications for organizational performance. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior, 30*(1), 119-139.
Lee, W. C. (2019). Pipelines, pathways, and ecosystems: An argument for participation paradigms. *Journal of Engineering Education, 108*(1), 8-12.
Li, P. (2014). Hitting the ceiling: An examination of barriers to success for Asian American women. *Berkeley J. Gender L. & Just., 29*, 140.
Lin, Y.-c. (2015). Are you a protean talent? The influence of protean career attitude, learning-goal orientation and perceived internal and external employability. *Career Development International*.
Maguire, H. (2002). Psychological contracts: are they still relevant? *Career Development International*.
Malcom, L., & Malcom, S. (2011). The double bind: The next generation. *Harvard Educational Review, 81*(2), 162-172.
Malicky, D. (2003). A Literature Review on the Under-representation of Women in Undergraduate Engineering: Ability Self-Efficacy and the 'Chilly Climate.'. *age, 8*, 1.
Manai, A., & Holmlund, M. (2015). Self-marketing brand skills for business students. *Marketing Intelligence & Planning*.
Mason, M. (2010). Sample Size and Saturation in PhD Studies Using Qualitative Interviews. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research, 11*(3). doi:http://dx.doi.org/10.17169/fqs-11.3.1428
Mays, V. M., Coleman, L. M., & Jackson, J. S. (1996). Perceived race-based discrimination, employment status, and job stress in a national sample of Black women: Implications for health outcomes. *Journal of Occupational Health Psychology, 1*(3), 319.
McArdle, S., Waters, L., Briscoe, J. P., & Hall, D. T. T. (2007). Employability during unemployment: Adaptability, career identity and human and social capital. *Journal of Vocational Behavior, 71*(2), 247-264.
McCall, L. (2005). The complexity of intersectionality. *Signs: Journal of women in culture and society, 30*(3), 1771-1800.
Merriam-Webster. (Ed.) (2019) Merriam-Webster. Merriam-Webster.
Mills, A., Durepos, G., & Wiebe, E. (2010a). *Encyclopedia of Case Study Research*.
Mills, A., Durepos, G., & Wiebe, E. (2010b). Secondary Data As Primary. In *Encyclopedia of Case Study Research*: Sage.
Morton, T. R., & Parsons, E. C. (2018). # BlackGirlMagic: The identity conceptualization of Black women in undergraduate STEM education. *Science Education, 102*(6), 1363-1393.
Nakaso, D. (2012). Asian workers now dominate Silicon Valley tech. [August 2016]. *The Mercury News*. Retrieved from https://www.mercurynews.com/2012/11/29/asian-workers-now-dominate-silicon-valley-tech-jobs/
Nauta, M. M., Epperson, D. L., & Kahn, J. H. (1998). A multiple-groups analysis of predictors of higher level career aspirations among women in mathematics, science, and engineering majors. *Journal of counseling Psychology, 45*(4), 483.
Noeth, R. J., Cruce, T., & Harmston, M. T. (2003). Maintaining a strong engineering workforce. *ACT Policy Report, 5*.

Obiomon, P. H., Tickles, V. C., Wowo, A. H., & Holland-Hunt, S. (2007). Advancement of women of color in science, technology, engineering, and math (STEM) disciplines. In.
Oh, S. S., & Lewis, G. B. (2011). Stemming inequality? Employment and pay of female and minority scientists and engineers. *The Social Science Journal, 48*(2), 397-403.
Olson, T. H. (1980). *Career Concepts and Decision Styles.* Paper presented at the Academy of Management Briarcliff Manor, NY 10510.
Ong, M., Wright, C., Espinosa, L., & Orfield, G. (2011). Inside the double bind: A synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Educational Review, 81*(2), 172-209.
Pistrang, N., & Barker, C. (2012). Varieties of qualitative research: A pragmatic approach to selecting methods.
Prince, J. B. (1979). An investigation of career concepts and career anchors. *In Western Academy of Management Meeting, Portland.*
Prosser, J., & Loxley, A. (2008). Introducing Visual Methods. *Economic and Social Research Council (ESRC) National Centre for Research Methods*.
Prusak, L., & Davenport, T. (1998). Working knowledge: how organizations manage what they know.
Randel, A. E., Galvin, B. M., Gibson, C. B., & Batts, S. I. (2021). Increasing Career Advancement Opportunities Through Sponsorship: An Identity-Based Model With Illustrative Application to Cross-Race Mentorship of African Americans. *Group & Organization Management, 46*(1), 105-142.
Reips, U.-D. (2012). Using the Internet to collect data. In *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological.* (pp. 291-310).
Riley, D., Pawley, A. L., Tucker, J., & Catalano, G. D. (2009). Feminisms in engineering education: Transformative possibilities. *NWSA Journal*, 21-40.
Rincon, R., & Yates, N. (2018). Women of color in the engineering workplace: Early career aspirations, challenges, and success strategies. *Society of Women Engineers*.
Roberts, P., & Ayre, M. (2002). Did she jump or was she pushed? A study of women's retention in the engineering workforce. *International Journal of Engineering Education, 18*(4), 415-421.
Ross, M., Capobianco, B. M., & Godwin, A. (2017). Repositioning race, gender, and role identity formation for Black women in engineering. *Journal of Women and Minorities in Science and Engineering, 23*(1).
Ross, M., & Godwin, A. (2015). *Stories of Black women in engineering industry—Why they leave.* Paper presented at the 2015 IEEE Frontiers in Education Conference (FIE).
Ross, M. S. (2016). *A unicorn's tale: Examining the experiences of Black women in engineering industry.* Purdue University,
Ross, M. S., Huff, J. L., & Godwin, A. (2021). Resilient engineering identity development critical to prolonged engagement of Black women in engineering. *Journal of Engineering Education, 110*(1), 92-113.
Ruderman, M. N., Ohlott, P. J., Panzer, K., & King, S. N. (2002). Benefits of Multiple Roles for Managerial Women. *Academy of management journal, 45*(2), 369-386. doi:10.2307/3069352
Şahin, A., Tasci, M., & Yan, J. (2020). The unemployment cost of COVID-19: How high and how long? *Economic Commentary*(2020-09).
Sandoval-Lucero, E., Maes, J., & Klingsmith, L. (2014). African American and Latina (o) community college students' social capital and student success. *College Student Journal, 48*(3), 522-533.
Sargent Jr, J. F. (2017). The US science and engineering workforce: Recent, current, and projected employment, wages, and unemployment.
Schein, E. H. (1990). Career anchors and job/role planning: The links between career pathing and career development.
Schein, E. H. (1996). Career anchors revisited: Implications for career development in the 21st century. *Academy of Management Perspectives, 10*(4), 80-88.

Schenk, C. T., & Holman, R. H. (1980). A sociological approach to brand choice: the concept of situational self image. *ACR North American Advances*.
Secules, S., McCall, C., Mejia, J. A., Beebe, C., Masters, A. S., L. Sánchez-Peña, M., & Svyantek, M. (2021). Positionality practices and dimensions of impact on equity research: A collaborative inquiry and call to the community. *Journal of Engineering Education, 110*(1), 19-43.
Sheppard, S., Colby, A., Macatangay, K., & Sullivan, W. (2007). What is engineering practice? *International Journal of Engineering Education, 22*(3), 429.
Singh, R., Fouad, N. A., Fitzpatrick, M. E., Liu, J. P., Cappaert, K. J., & Figuereido, C. (2013). Stemming the tide: Predicting women engineers' intentions to leave. *Journal of Vocational Behavior, 83*(3), 281-294.
Slaughter, J. B., Tao, Y., & Pearson, W. (2015). *Changing the face of engineering: The African American experience*: JHU Press.
Solórzano, D. G., & Yosso, T. J. (2002). Critical race methodology: Counter-storytelling as an analytical framework for education research. Qualitative inquiry, 8(1), 23-44.
Souza, R., Malta, K., & De Almeida, E. S. (2017). *Software engineering in startups: A single embedded case study.* Paper presented at the 2017 IEEE/ACM 1st International Workshop on Software Engineering for Startups (SoftStart).
Stake, R. E. (2008). Case Studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *Strategies of Qualitative Inquiry* (Vol. 2). Thousand Oaks, CA: Sage.
Statistics, B. o. L. (2018). Employee Tenure in 2018 [Press release]. Retrieved from https://www.bls.gov/news.release/tenure.nr0.htm
Stevens, C., & Turban, D. (2001). *Impact of job seekers' search strategies and tactics on search success.* Paper presented at the annual conference of the Society for Industrial and Organizational Psychology.
Super, D. E. (1980). A life-span, life-space approach to career development. *Journal of Vocational Behavior, 16*(3), 282-298.
Taggar, S., & Kuron, L. K. (2016). The toll of perceived injustice on job search self-efficacy and behavior. *Career Development International*.
Tankovska, H. Statista (2021). Social Media & User Generated Content: Percentage of U.S. population who currently use any social media from 2008 to 2021. https://www.statista.com/statistics/273476/percentage-of-us-population-with-a-social-network-profile/
Tenzek, K. E. (2017). Negative Case Analysis. In *Encyclopedia of Communication Research Methods*: Sage.
Thelwall, M. (2001). A web crawler design for data mining. *Journal of Information Science, 27*(5), 319-325.
Tsang, E. W. (2013). Case study methodology: Causal explanation, contextualization, and theorizing. *Journal of international management, 19*(2), 195-202.
Van Hoye, G., Van Hooft, E. A., & Lievens, F. (2009). Networking as a job search behaviour: A social network perspective. *Journal of Occupational and Organizational Psychology, 82*(3), 661-682.
Varma, R. (2002). High-tech coolies: Asian immigrants in the US science and engineering workforce. *Science as Culture, 11*(3), 337-361.
Vogt, C. M. (2008). The continuing technological revolution: A comparison of three regions' strategies for creating women-inclusive workplaces. *HMG Watt, & JS Eccles (Eds.)*, 323-351.
Voydanoff, P. (2001). Incorporating community into work and family research: A review of basic relationships. *Human Relations, 54*(12), 1609-1637.
Walther, J., Sochacka, N. W., & Kellam, N. N. (2013). Quality in interpretive engineering education research: Reflections on an example study. *Journal of Engineering Education, 102*(4), 626-659.
Walton, G. M., Logel, C., Peach, J. M., Spencer, S. J., & Zanna, M. P. (2015). Two brief interventions to mitigate a "chilly climate" transform women's experience, relationships, and achievement in engineering. *Journal of Educational Psychology, 107*(2), 468.

Wang, M. T., Eccles, J. S., & Kenny, S. (2013). Not lack of ability but more choice: individual and gender differences in choice of careers in science, technology, engineering, and mathematics. *Psychol Sci, 24*(5), 770-775. doi:10.1177/0956797612458937
Waterhouse, J. (2007). From narratives to portraits: methodology and methods to portray leadership. *Curriculum Journal, 18*(3), 271-286. doi:10.1080/09585170701589884
Wicklein, R. C. (2006). Five good reasons for engineering as the focus for technology education. *The Technology Teacher, 65*(7), 25.
Wu, J. J., & Atkinson, R. D. (2017). How Technology-Based Start-Ups Support US Economic Growth. *Information Technology & Innovation Foundation ITIF, November*.
Yeh, Q.-J. (2008). Exploring career stages of midcareer and older engineers---when managerial transition matters. *IEEE transactions on engineering management, 55*(1), 82-93.
Yin, R. K. (2012). Case study methods. In *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological.* (pp. 141-155).
Yin, R. K. (2015). Case Studies. *International Encyclopedia of the Social and Behavioral Sciences, 3*, 195-201.
Yoder, B. (2017). Engineering by the numbers. Washington, DC: American Society for Engineering Education. In.
Yosso*, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race ethnicity and education, 8*(1), 69-91.

Appendix

A. Email Consent to Use Existing Data

Subject: Seeking Consent to Use Existing Data for Research

As a fellow woman of color, I am curious about the career trajectories of Black women. I am specifically looking to understand what values, experiences and goals influence the way Black women move into, across and out of the tech industry.

I designed this study around existing and publicly available social media artifacts that contain career data for Black women in tech. Because you were one of the people that came up in my searches, I am writing to request your permission to analyze the existing data I found regarding your tech career.

Here is a link to an informed consent document containing more details about the study and how to indicate your consent to having your existing data analyzed for my research.

https://forms.gle/ARrCq2jsc1WCNGyk8

Thank you for your consideration, if you have questions please contact Janice Hall (janch@vt.edu).

Janice

B. IRB Informed Consent Document to Use Existing Data

Title of Research Study: A case study on the varied engineering career orientations of Black women in Tech (IRB Protocol # 19-1141)

Investigator(s): Walter C. Lee, PhD; Engineering Education; 540-231-3234; walterl@vt.edu
Janice Hall; Engineering Education; janch@vt.edu

Key Information: The following is a short summary of this study to help you decide whether to be a part of this study. More detailed information is listed later in this form. My name is Janice Hall, and I am a PhD at Virginia Tech. Under the advisement of Dr. Walter Lee, the purpose of my dissertation is to describe the varied career orientations of Black women working as engineers in tech and link career orientations to their career outcomes. I designed this study around existing data (found via Google searches) because of the richness in online communities of Black women in tech that were already discussing content and workplace experiences transparently. Because you were one of the people that came up in my searches, I am writing to request your permission to analyze the data I found on your tech career in my study.

Detailed Information: The following is more detailed information about this study in addition to the information listed above. With an interest in improving the diversity in the tech industry and in the engineering profession, I have designed a study to describe the career patterns of Black women in tech to understand how Black women make meaning of a career and what a career for them looks like. By analyzing the career patterns of multiple Black women, I hope to improve their fit within organizations and the engineering workforce more broadly. To identify existing data, I began my Google search with the term Black women in Tech and your name was listed among other Black women on Jeneba Ghatts curated list of Black women in Tech to follow on Twitter. From this curated list I searched your name and found the following data sources about your career in tech:

[insert specific weblinks to data sources about subjects' career]

All identifying information will be removed so that just the underlying job pattern(s), values, decisions, and strategies remain. I will then compare findings across Black women to an existing career orientations framework and look for themes in the data. Based on findings of common themes I will create visual illustrations of the various career orientations I find across all subjects.

Who can I talk to?

If you have questions, concerns, or complaints, or think the research has hurt you, talk to the research team at *(Janice Hall, janch@vt.edu; Walter C. Lee, walterl@vt.edu)*

This research has been reviewed and approved by the Virginia Tech Institutional Review Board (IRB). You may communicate with them at 540-231-3732 or irb@vt.edu if:

- You have questions about your rights as a research subject
- Your questions, concerns, or complaints are not being answered by the research team
- You cannot reach the research team
- You want to talk to someone besides the research team to provide feedback about this research

How many people will be studied?

We plan to include about __12___ people in this research study.

What happens if I say yes, I want to be in this research?

If you consent to your career data being used in this study, there is no immediate action required on your part. I will conduct an analysis on existing social media artifacts pertaining to career patterns and after looking across the full data set of 10 subjects I will construct visual illustrations of the findings. I anticipate finishing the analysis of the data in June 2020.

What happens if I say yes, but I change my mind later?

You can leave the research at any time, for any reason, and it will not be held against you. If you decide to leave the research, contact the investigator so that the investigator can remove your data from the analysis. All data sources regarding your career-related information will be deleted.

Is there any way being in this study could be bad for me? (Detailed Risks)

There are no known risks to participating in this study.

What happens to the information collected for the research?

We will make every effort to limit the use and disclosure of your personal information only to people who have a need to review this information. We cannot promise complete confidentiality. Organizations that may inspect and copy your information include the IRB, Human Research Protection Program, and other authorized representatives of Virginia Tech.

The data will be deidentified and the results of this research study will be shared with other subjects meeting the study inclusion criteria (e.g., Black women in tech) for validation of career orientations among the broader community who are less visible online. The findings may be presented in summary form at conferences, in presentations, academic papers, and as part of a thesis/dissertation.

What else do I need to know?

We will offer to share your individual case analysis findings with you. You may accept or decline these findings. At the end of the analysis (estimated end of spring 2020) we will be seeking feedback on the visual illustration of the study findings. Requests for feedback, scheduling and compensation details will occur at a later date (estimated early summer 2020).

Subject's Responsibility

If you consent to your public and existing career data to be used in this study, please indicate so by responding via email to janch@vt.edu. Response emails will be collected as proof of consent.

C. Email to Solicit Member Checking

Sample E-mail prompt text:

Hello [insert name here],

I hope this message finds you well. My name is Janice Hall, and I am pursuing my PhD at Virginia Tech under the advisement of Dr. Walter Lee. I am soliciting feedback on my research findings through member checking. I have recently completed the analysis for my dissertation: *A case study on the varied engineering career orientations of Black women in Tech (IRB Protocol #19-1141*). I am writing to request your feedback on the major career attitudes and patterns found after qualitative analysis of 10 Black women in tech.

Your participation in member checking is completely voluntary; however, if you wish to participate in member checking you will be compensated for your time and effort. Compensation will occur in the amount of a $25 Amazon gift card. I anticipate no more than a 60 minute virtual meeting in which you react to a short description of the major themes that resulted from the study. Your feedback will be used to improve the validity of the study findings.

Sample LinkedIn Connect text (character limit):

Hi , my name is Janice Hall. I am pursuing a PhD at Virginia Tech. I am writing to solicit feedback on my dissertation findings. I did a qualitative career study on Black women in tech, if interested please respond with an email address.

D. IRB Informed Consent to Participate in Member Checking

Title of Research Study: A case study on the varied engineering career orientations of Black women in Tech (IRB Protocol # 19-1141)

Investigator(s): Dr. Walter Lee and Mrs. Janice Hall

Key Information: The following is a short summary of this study to help you decide whether to be a part of this study. More detailed information is listed later on in this form. The purpose of this study is to describe the varied career orientations of Black women working as engineers in Tech and link career orientations to their career outcomes. This round of feedback will focus on subjects' comments, interpretations, and concerns regarding the visual illustrations of the study findings to confirm researcher interpretation of data.

What happens if I say yes, I want to be in this research?
Unstructured interviews will be conducted to gather feedback on the visual illustrations of major career orientations resulting from the case analysis. These interviews will be conducted virtually via Zoom platform, or an alternate platform specified by the participant (e.g., phone). We estimate that the interview will take 60 minutes. During this interview, you will be asked to "think aloud" while reviewing the visual illustration that your career data matched into. Additionally, we will ask you how you are interpreting the symbols, directionality of career decisions implicated on the visual, making sure your actual career experience and the researcher's interpretations of your career data are aligned. The interview will not be audio or video recorded; however, the researcher will take notes during the interview. Additionally, if the participant chooses to make any digital alterations or additions to the visual portrait, it may be collected or saved as data.

What happens if I say yes, but I change my mind later?
You are free to withdraw from participation at any time without prejudice, penalty, or any other negative consequences.

How many people will be studied?
We plan to include about 24 people in the member checking.
Is there any way being in this study could be bad for me? (Detailed Risks)

There are no known risks to participating in this study.

What happens to the information collected for the research?
We will make every effort to limit the use and disclosure of your personal information only to people who have a need to review this information. We cannot promise complete confidentiality. Organizations that may inspect and copy your information include the IRB, Human Research Protection Program, and other authorized representatives of Virginia Tech.

The researcher will be taking notes during the interview, any identifying information will be removed from the notes and pseudonyms (i.e., false names) will be used for your name and for the names of any other people or entities who you mention. These pseudonyms will also be used in preparing all written reports of the research. The findings may be presented in summary form at conferences, in presentations, academic papers, and as part of a thesis/dissertation.

What else do I need to know? (Benefits)

You will receive a receive a $25 Amazon Gift Card for your participation in this study. Participant compensation is to be paid within 24 hours after completion of the interview.

Who can I talk to?
If you have questions, concerns, or complaints, or think the research has hurt you please contact the investigators:

Mrs. Janice Hall ……. janch@vt.edu
Dr. Walter Lee ……. walterl@vt.edu

This research has been reviewed and approved by the Virginia Tech Institutional Review Board (IRB). You may communicate with them at 540-231-3732 or irb@vt.edu if:

- You have questions about your rights as a research subject
- Your questions, concerns, or complaints are not being answered by the research team
- You cannot reach the research team
- You want to talk to someone besides the research team to provide feedback about this research

Subject's Responsibilities (please read audibly)

I voluntarily agree to participate in this study and acknowledge that I am over the age of 18. I have the following responsibilities:

-I agree to answer questions honestly
-I agree to allow the researcher to audio record the interview
-I agree to allow the researcher to use direct quotes with a pseudonym

Subjects Permission (please read audibly)

I have read the Consent Form and conditions of this project. I have had all my questions answered I hereby acknowledge the above and give my voluntary consent.

E. Visual Portrait - Wanderer

Orientation: Protean-Boundaryless Hybrid

Psychological Mobility/Dimensions:

1. *Boundaryless mindset*
2. *Mobility preference*
3. *Self-directed*
4. *Values-driven*

Major Career Themes/Values
social good
tech empowerment
work life integrity
community
extra-organizational networks
career authenticity

Physical Mobility

Hybrid: Wanderer

Protean Categories			
		Values-Driven	
		Low	High
Self-Directed	Strong	Reactive	Transformational
	Low	Dependent	Rigid

- *Highly physically mobile but exhibits far less psychological mobility.*
- Reactive opportunity seeking
- *Not limited by organizational or geographical boundaries as barriers, a career explorer*

Boundaryless Categories			
		Mobility Preference	
		Low	High
Boundaryless Mindset	Strong	3	4
	Low	1	2

Challenges
Self: *Continuously find new interests to pursue*

Support: *Help develop self-direction, criteria to establish whether this is a good-fit after new decisions are made*

F. Visual Portrait - Transformist

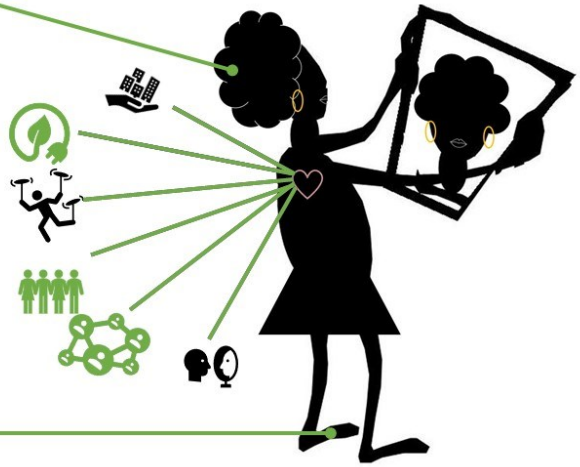
Orientation: Protean-Boundaryless Hybrid

Psychological Mobility/Dimensions:

1. *Boundaryless mindset*
2. *Mobility preference*
3. *Self-directed*
4. *Values-driven*

Major Career Themes/Values

social good
tech empowerment
work life integrity
community
extra-organizational networks
career authenticity



Physical Mobility

Hybrid: Transformist

Protean Categories			
		Values-Driven	
		Low	High
Self-Directed	Strong	Reactive	Transformational
	Low	Dependent	Rigid

- *Highly self directed with clear sense of priorities for their career contributions*
- Able to lead themselves and others, are more capable of continuous learning, and thus "transformational."
- *Physically boundaryless (e.g. enjoys travel for work)*

Boundaryless Categories			
		Mobility Preference	
		Low	High
Boundaryless Mindset	Strong	3	4
	Low	1	2

Challenges:
Self: *Find stable opportunities that match curiosity and build adaptability*

Support: Find challenges to push out of comfort zone and help build competency and adaptability skills

G. Visual Portrait – Solid Citizen

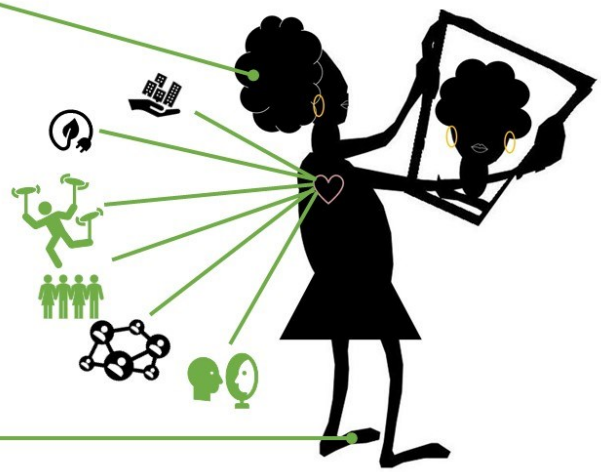
Orientation: Protean-Boundaryless Hybrid

Psychological Mobility/Dimensions:

1. *Boundaryless mindset*
2. *Mobility preference*
3. *Self-directed*
4. *Values-driven*

Major Career Themes/Values

social good
tech empowerment
work life integrity
community
extra-organizational networks
career authenticity



Physical Mobility

Hybrid: *Solid Citizen*

Protean Categories			
		Values-Driven	
		Low	High
Self-Directed	Strong	Reactive	Transformational
	Low	Dependent	Rigid

Boundaryless Categories			
		Mobility Preference	
		Low	High
Boundaryless Mindset	Strong	3	4
	Low	1	2

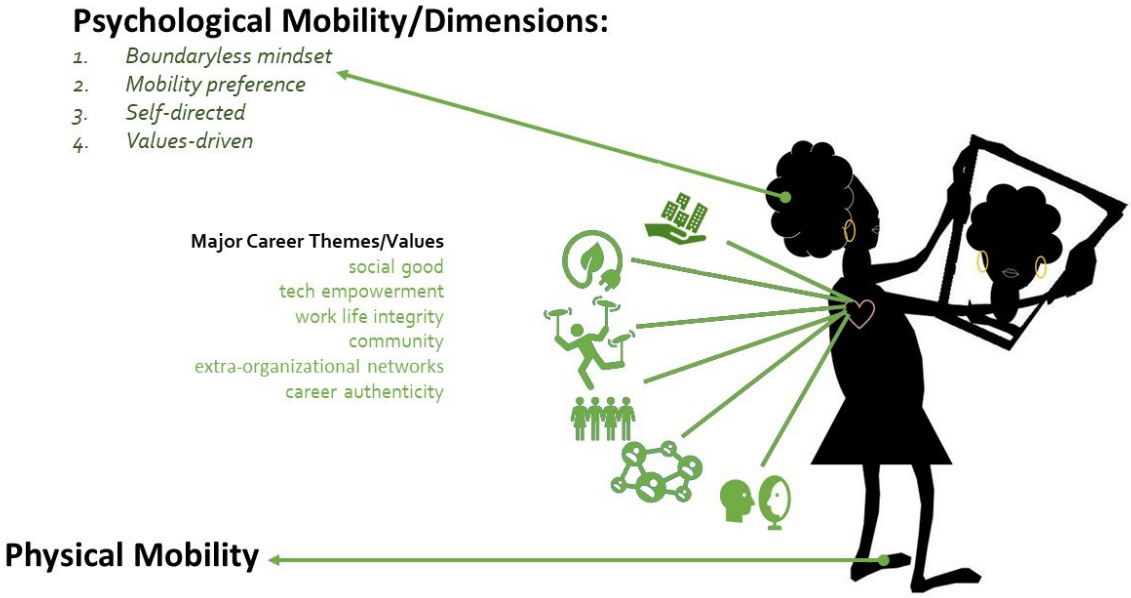
- *Strongly protean*
- *Need to find a "home" for their career that matches:*
  - *values*
  - *allows them autonomy*
  - *satisfy curiosity and learning drive through work*

Challenges
Self: Person-organization fit a must. Mobility a threat.

Support: Maintain diversity of talent but leverage solid citizen's contributions

H. Visual Portrait – Protean Career Architect

Orientation: Protean-Boundaryless Hybrid



Hybrid: Protean Career Architect

Protean Categories			
		Values-Driven	
		Low	High
Self-Directed	Strong	Reactive	Transformational
	Low	Dependent	Rigid

- *Both psychologically and physically boundaryless, on a quest to define meaning and success; deciding where to apply their ability (e.g. "where can I have greatest impact")*
- Able to lead themselves and others, are more capable of continuous learning, and thus "transformational."
- *Career as a calling*

Boundaryless Categories			
		Mobility Preference	
		Low	High
Boundaryless Mindset	Strong	3	4
	Low	1	2

Challenges
Self: *Leverage capability into meaningful impact*

Support: Provide stages on which to shine, learn, engage. Temper if need.

I. Visual Portrait – Community Member Checking (High-Level Findings)