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ENGINEERS' PERCEPTIONS OF DIVERSITY AND THE LEARNING ENVIRONMENT AT WORK: A MIXED METHODS STUDY

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Brenda L. Firestone

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The dissertation of Brenda L. Firestone was reviewed and approved* by the following:

Elizabeth Tisdell
Professor of Adult Education
Program Coordinator, Doctor of Education in Adult Education
Dissertation Advisor
Chair of Committee

Edward Taylor
Professor of Adult Education

Barbara Sims
Professor of Criminal Justice

Katherine Baker
Associate Professor of Environmental Microbiology

Gary W. Kuhne
Co-Professor in Charge of Graduate Programs in Adult Education

*Signatures are on file in the Graduate School.

ABSTRACT

The purpose of this dissertation research study was to investigate engineers' perceptions of diversity and the workplace learning environment surrounding diversity education efforts in engineering occupations. The study made use of a mixed methods methodology and was theoretically framed using a critical feminist adult education lens and organizational diversity theory. As such particular attention was paid to gender, race and age in the data collection and findings. A culture climate instrument was developed, seven factors that relate to diversity climate were identified and the questions for each theoretical dimension were tested for scale reliability. The culture climate survey collected data from a random sample of engineers designated as professional engineers (PEs) in Pennsylvania. Findings confirm the extreme underrepresentation of engineers of color; 94 % of the random sample consisted of White engineers. Although women were also underrepresented, a stratified sampling technique resulted in women representing 45% of the sample. Findings indicate that overall these engineers have favorable perceptions of the engineering culture climate. Female engineers' perceptions, while still favorable, are less favorable than their male counterparts. Gender is a significant predictor of perceptions for the culture climate indices while age is a predictor for some of the indices. Qualitative data were collected by semi-structured interviews from a purposefully selected sample of eight female engineers that included two women of color. While confirming some of the traditional barriers for women in engineering such as the need to prove themselves as competent engineers, they indicate that there are engineering worksites that are flexible and meet their family needs, but they did perceive differential treatment based on gender, race and age. Other qualitative findings include an unsubstantiated and for the most part disputed by female engineers, meta narrative that engineering is an occupation that is not subject to racial or gender prejudice. The study concludes that engineering could benefit from an understanding of critical adult education and diversity theory including the concept of subjectivity in knowledge, perceptions and learning.

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Acknowledgements

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CHAPTER 1: INTRODUCTION

This chapter introduces and provides the foundation for a mixed methods research study examining workplace learning, diversity initiatives and engineers' perceptions of diversity around race, ethnicity, and gender in engineering occupations. In Western culture, engineering is typically referred to as a traditionally male profession and past research has tended to focus on the lack of female participation (Frehill, 2007; Gibbons, 2008; Kimmel, 2008). In light of, an increasingly diverse United States population and a shrinking engineering workforce, the study is grounded in a workplace diversity and critical adult education paradigm that attends to feminist and diversity issues. This chapter includes a background of the issue, the purpose of the study, and the theoretical frameworks that guide the investigation of the issue. Additionally, the significance, definition of terms, assumptions, and limitations will be addressed.

Situating the Problem

There has been much discussion in recent years on the issue of workplace diversity. While this has been a concern in all disciplines and professions, women and people of color are particularly underrepresented in the science, engineering, technology, and mathematics (STEM) disciplines. A National Academies report, *Rising Above the Gathering Storm* (National Academy of Sciences, 2007) warns of a national loss of competitiveness in the global market due to a shortage of scientists and engineers and implicates the lack of a diverse workforce. The report encourages STEM disciplines to examine exclusive practices and policies that currently limit the participation of underrepresented groups.

Attention to diversity issues is not new to American business, nor to the field of adult education. The 1987 publication of *Workforce 2000: Work and Workers for the Twenty-First Century* (Johnston & Packer) predicted that the majority of new workers would be women and

minorities and prompted corporate America to examine exclusionary workplace policies that result in excluding various groups and implement initiatives that promote diversity. Although many organizations heeded this warning and took steps towards diversity management through various educational diversity programs, their efforts frequently did not result in a more diverse work culture (Cox, 2001). Beyond research focused on a lack of women and the obstacles they face in a traditional male environment, little is known about diversity initiatives in STEM. However, given that engineering culture is defined by a technical base and strongly identifies with technical learning and knowledge, it is not surprising that a socio-cultural issue like diversity remains elusive (Faulkner, 2007).

Some theorize that a lack of understanding of the complexity of adult learning is responsible for the failure of workplace diversity initiatives (Cox, 2001; Kell, Shore & Singh, 2004). Additionally, diversity initiatives that do not include a critical perspective are often perceived by underrepresented populations as superficial and by dominant groups as threatening (Brown, 2004; Rasmussen, 2007). Thus, the field of engineering could benefit from some of the insights from critical adult education, feminist perspectives and workplace learning. This will be examined first in light of a consideration of the context of the engineering workplace in regard to gender and diversity and then through a brief discussion of adult learning as it relates to the workplace.

The Culture of Engineering

Although this study is about workplace learning and the diversity climate in engineering occupations, as implied above, engineering is frequently grouped and researched in conjunction with other fields, specifically science, technology and math. Consequently, much of the existing body of knowledge is presented within the context of science, technology, engineering and math,

typically denoted as STEM. Additionally, engineering is a professional occupation that usually requires an undergraduate engineering degree and a large body of research that examines the lack of participation and diversity in engineering is focused on the academic environment. Furthermore, the term engineering signifies various fields of practice that includes specific disciplines such as civil, architectural and mechanical among others. Past research that aggregates all engineering disciplines may be missing important nuances in the culture of individual disciplines. The current study pays particular attention to how an individual engineer's race gender, and age, among other things affect perceptions of diversity.

Much of the previous research on inequality in engineering focused on the lack of female participation at the academic level. For example, although women now enter higher education at rates estimated over 50%, they lag far behind their male counterparts in enrolling in STEM degree programs (Litzler, Lange, & Brainard, 2005). Overall female enrollments in STEM academic programs average an estimated 17% (Gibbons, 2008; US Dept. of Education, 2008). It is also important to recognize that some disciplines such as biology, life sciences and chemistry for example, attract women at much higher rates of 50 to 60%, while mechanical/industrial engineering and physics languish at the bottom with enrollment estimates between 10 and 13% (Frehill, 2007; Koehler, 2008; Kuck, 2005). Of particular note is information technology (IT), where the number of women receiving computer science and engineering degrees has steadily decreased since the 1980s. The United States and United Kingdom have experienced the most significant declines for women in IT from approximately 25% in the 1980s to 20% in 1997 (Panteli, Stack & Ramsay, 1999; Trauth, 2002).

Depending on one's viewpoint, various factors have been identified as contributing to the lack of women in higher education STEM degrees including: a K-12 educational system that

supports gender bias, social construction/cognitive identity, biological characteristics, instructional strategies, gender and cultural bias in higher education, a lack of mentors and models and organizational culture and structure that inhibit equal opportunity (Frehill, 2007; U.S. Department of Education, 2008). Recent statistics indicate a downward trend in STEM graduation rates overall (earned bachelor degrees dropped by 22% since 1985) and the literature suggests repositioning engineering as a bridge between the technical and the social, examining traditional engineering curriculum and providing flexible work environments as strategies to improve participation in engineering (Gibbons, 2008; Koehler, 2008; Marjoram, 2003). Also, at a time when female representation in the overall workforce is increasing, their presence in STEM occupations remains low.

As will be discussed further in Chapter Two, research in STEM professions identifies hostile work environments, discrimination, the need to assimilate, lack of mentoring and modeling, and an unequal work and family balance as major themes contributing to women not entering or opting out of STEM careers (Tapia, 2006; Trauth, 2002). A longitudinal mixed methods study on career development of adolescents with information technology (IT) career aspirations, points to "anticipated discrimination" (Messersmith, Garrett, Davis-Kean, Malanchuk, & Eccles, 2008, p 223) as a major factor in women not pursuing careers in IT. Additionally, a higher percentage of women who participated in women in engineering (WIE) and/or women in science and engineering (WISE) programs at the university level indicated they are not working in the field of their major (Litzler, et al., 2005). Although Litzer et al.'s (2005) study did not directly address the reasons for this lack of persistence, researchers offered three possible rationales; students were more aware of the difficulties of working in a STEM field because of their involvement with WIE/WISE services, students who participate in WIE/WISE

have greater concerns about work/family balance, and although WIE/WISE participants indicated that they would not be in a STEM field they will be doing technical work but in a nontechnical occupation. Frehill (2007) reports that after graduation the percentage of women entering the engineering workforce is only slightly less than the percentage of men, but they continue to opt out at a higher rate long after the male attrition rate stabilizes.

The loss of women in STEM as their education and careers progress is often referred to as the "leaky pipeline" (Blickenstaff, 2005, p. 369), and is in part responsible for the lack of female presence in higher management positions, a situation that supports the maintenance of the status quo. Furthermore, women who opt out of STEM careers suffer financial consequences and if they return to STEM positions (many who do return to work choose more traditional female employment such as teaching), many occupy part-time positions (Panteli, Stack, & Ramsay, 1999). Tapia (2006) and Trauth (2002) posit that the requirement of employee extended availability and work culture norms that expect employees to place their employers' needs above their own do not meet women's reality, especially when dominant social norms perceive women as responsible for most of the familial responsibilities including elder care (Kimmel, 2008). Tracy (1998) indicated that role models, particularly those claiming that women could "have it all" (p. 1), may be discouraging women from entering STEM fields. The students did not believe that women can be good employees in STEM fields and good wives, mothers, etc. Some of the skepticism was attributed to the students' perceptions that women were responsible for most of the family caretaking and, therefore, would not be able to invest the required time and energy required for STEM careers.

As Kimmel (2008) notes, the traditional separation of work where men dominated the public sphere and the private or domestic sphere was seen as the women's domain, may account

for a traditional culture in engineering occupations because it was created by men and reflect a dominant male paradigm in regards to the expectation of long hours and unlimited availability [to work]. Additionally, this dominant ideology is based on out-of-date social norms for white middle class men and may be responsible for the lack not only of female representation, but also the lack of racial, cultural and age diversity in engineering (Boushey & O'Leary, 2009; Kimmel, 2008). Considering the previous information, it would seem that the dominant narrative of the workplace as gender-, race- and class-neutral is simply not reflected in practice. Research in organizational climate in general supports this conclusion, for as Cox (2001) notes, most organizational culture "is somewhere between toxic and deadly when it comes to handling diversity" (p. 12). Brooks and Clunis (2007), in their review and synthesis of literature and research on race and ethnicity in workplace learning report similar results.

Much of the past research on the lack of diversity in STEM focused on higher education and used a "women as deficient" (Bystydienski & Bird, 2006, p. 4) framework that unavoidably positioned gender as the culprit and women as lacking in math and science skills, self efficacy, and a competitive nature among other things (Kimmel, 2008; Litzler, et al, 2005; Phipps, 2007). Using this perspective has resulted in placing the blame on women and the implication that they need to change to fit into masculine STEM environments. The combination of the lack of research focused specifically on workplace learning and organizational diversity climate (baseline climate assessment data) in engineering and how race, culture, gender, and age, etc. intersect to affect engineers' perceptions of the diversity climate prevents a complete understanding of why engineering remains a traditional white male occupation.

Additionally, organizational change requires participation of all constituents. Too often, lack of perspective from the dominant group creates fear and resistance as diversity initiatives are

often interpreted as “employment gains for women and racial-minority men at the expense of the traditional power group, white men” (Cox, 2001, p. 60). Although developing cultural competence through diversity initiatives might seem a positive step forward, it is also important to demonstrate through research, education and evaluation that building cultural competency has benefits for everyone and contributes to the long-term sustainability of the organization (Cox, 2001). Thus, the incongruity between hegemonic definitions of masculinity and femininity, contemporary social realities that reflect gender and cultural diversity in the workforce and perceptions that only women’s lives and STEM work culture and structures are incompatible is an important though undeveloped area of research (Boushey & O’Leary, 2009). Theoretical and research insights from the field of adult education can offer some direction here.

Adult Education and Adult Learning in the Workplace

There is a wide body of adult education research and theory that focuses on dealing with structural inequities based on gender, race, culture, and class in the process of educating adults in classrooms and in the workplace. While this will be discussed further in Chapter Two, many of these discussions and research studies are informed by critical theory, feminist theory, critical race theory, and critical multicultural perspectives on education.

Critical and feminist scholars in adult education are concerned with power structures and challenging dominant ideology; the “belief system, values and practices” (Brookfield, 2004, p. 68) that appear natural and serve to reproduce social systems that advantage some groups over others. Critical and emancipatory educator Paulo Freire focused on class as a source of oppression and advocated for the development of a critical consciousness. This critical consciousness helps people become aware of the connections between dominant ideology and oppression and is achieved through critical reflection, dialogue and an understanding of

subjective knowledge (Elias & Merriam, 2005). Feminist critiques of traditional critical theory include a reliance on male centrist theory and an exclusion of gender as a source of oppression (Brookfield, 2004; Lather, 2001).

In response, feminist theory in general focuses on power relations and social structures that differentiate humans on the basis of gender and result in men being privileged. However, this perspective of gender as a main source of oppression unintentionally reinforced a white middle-class norm by suppressing the varying experiences of women of color and those of lower social economic status (hooks, 2000). These critiques of essentializing women and women's lived realities resulted in developing critical theories that examined multiple sources of oppression.

Critical race theorists examine oppression through the social construction of race (race as a means of differentiation and oppression) and seek to advance a social justice framework. In an emancipatory perspective, critical race theory also aims to redress social inequalities. Additionally, recognizing that race and racism work with and through gender, ethnicity, class, sexuality, etc. as systems of power, contemporary critical race theory often includes these intersections in their analysis (Johnson-Bailey & Cervero, 2008; Ladson-Billings & Tate, 1995; Barrett, Cervero & Johnson-Bailey, 2003). This acknowledgement of multiple and sometimes additive sources of oppression is specifically addressed by a poststructural feminist perspective via the concept of positionality.

Poststructural feminist theory attempts to move the analysis beyond standpoints such as gender and race by acknowledging multiple systems of oppression and privilege that exist between humans. In other words, people are intersections of positionalities such as race, gender, age, etc. and those intersections influence how they experience and make meaning in life, and

construct knowledge about the world. Additionally, a person's understanding of their positionality is fluid which can affect and change over time the meaning they associate with identities such as wife, mother, or worker (Tisdell, 2001).

Poststructural feminists also emphasizes the importance of deconstructing binary opposites, such as "men are this, women are that", and thus challenge notions of essentialism. Further, because of the emphasis on positionality, they argue that knowledge is socially constructed by human beings who are informed by multiple social systems, such as race, class, and age, and not just gender. Thus, they view all knowledge as constructed, and subjective to some degree, since all knowledge is created and mediated by human experience, and based on the positions people occupy in life resulting in multiple realities (English, 2006). In contrast, the dominant science narrative views all *real* knowledge as objective, and tends to ignore the fact that scientific knowledge is also created and mediated by human beings through their experience and observations. Consequently, scientific knowledge has tended to serve to privilege those who have traditionally been responsible for knowledge production in the sciences - white men of means. This invisibility of privileging so-called *objective* knowledge marginalizes those who do not occupy positions of dominance and is present in all aspects of life.

Critical and feminist theory in adult education is most frequently applied to higher education environments in an analysis of curriculum and pedagogy that seeks to unmask power relations and encourages social action and change. Some characteristics of critical and feminist theory in action include attention to how positionality shapes knowledge production processes and attention to "critical self awareness" (Hunt, 2006, p. 52) in the classroom, acknowledgement of power relations and multiple pedagogical practices (Brookfield, 2006; English, 2006). But there are adult education scholars who have applied these critical and feminist perspectives to

workplace learning (Bierema, 2008; Brooks & Clunis, 2007; Fenwick 2006, 2008), and these perspectives are particularly related to this study of engineers.

Workplace learning is a topic that crosses disciplines with different philosophical and epistemological underpinnings such as adult education, human resource development and organizational management leading to a confusion of terms and applications. Within this large body of literature there are many different meanings of work, workplace and workplace learning, as well as different philosophical and theoretical orientations that inform studies and discussions of workplace learning and organizational learning (Fenwick, 2006; 2008). Additionally, whether the focus is on individual learning or organizational learning or both is not always clear.

Work and the workplace are also political sites that can reinforce or challenge dominant ideology (Kimmel, 2008). All too frequently workplace learning falls in the *benefit the organization process*, and issues of power and privilege remain invisible (Kell, et al., 2004). Currently, a counter neo-conservative global perspective informs the debate on workplace learning; one that calls for adult educators to enhance worker's "capacity for analytical and strategic thinking…understand the investments [they] have in [their] own prejudices and stereotypes and understand the need for multiple perspectives of the world" (Kell, et al., 2004, p. xix). From this "identity politics" (Fenwick, 2008, p. 24) viewpoint, many adult educators are concerned about issues of inequality and power and support critical processes and pedagogy that make these issues visible. Questions such a who is in control of the learning, what is being taught, how it is being taught and who benefits can serve to make visible inequalities, prompt a change in values and beliefs that maintain social injustice and promote democratic work environments (Hatcher & Bowles, 2006).

Toward that end, Brooks and Clunis (2007) recently conducted a review of 89 articles dealing with the research and literature on race and ethnicity in workplace learning from 1980 - 2005. They conclude that while the research addresses issues such as obstacles and mentoring, for the most part the research does not address the complexity of the dynamics related to race and ethnicity in the workplace around structural inequalities. They recommend that studies be informed by theoretical and philosophical perspectives that make these issues visible. Further, in their review they refer briefly to one dissertation about diversity and workplace learning in engineering, and note that for the most part studies of workplace learning specifically about engineering and issues related to diversity is lacking. The current research is informed by the workplace learning adult education literature that can make these issues visible in the engineering workplace.

Diversity and Workplace Learning for Engineers

As noted above much of the critical and feminist adult education literature highlights how issues of positionality (gender, race, class etc.) can affect curriculum design and educational processes, more often in more formal educational situation. The diversity in the workplace learning literature has focused more on organizations in general, with little attention to engineers.

However, Rasmussen (2007) offers an organizational diversity model, the "diversity mosaic," which incorporates critical theory concepts highlighting an importance on *dimensions of diversity* that mirror poststructural feminism's concept of positionality and the importance of critical self reflection of the facilitator. Furthermore, the author is specific that focusing on dimensions of race and gender while excluding other dimensions is a likely cause of failure of diversity initiatives. In a critical examination of dominant ideology, Rasmussen explicitly states that diversity initiatives are not training programs where we teach people to *be nice* to each other,

but long term systemic organizational change activities that require an examination of structural inequality that is excluding but seen as natural and normal. Given that paradigmatic shifts of thinking about organizational culture and the beliefs, assumptions and relationships of individuals that make up organizations are not immediately tangible and may require an extended process for learning outcomes to be observable and measurable, a long term continuous loop process is required (Cox, 2001; Rasmussen, 2007).

The current research study will also investigate the "problematic binary" (Fenwick, 2006, p. 272) of formal (an intentional structured presentation of educational material for the purposes of knowledge acquisition) and informal learning (not structured or controlled learning), once again recognizing the workplace as a political institution where hidden curriculum may function to reinforce or critique formal learning objectives. Both of these issues make diversity initiatives particularly problematic in engineering worksites. Engineering epistemology is heavily tied to a rational scientific paradigm that values procedural knowledge with tangible application whereas education designed to change beliefs and assumptions is less concrete and benefits from an acceptance of subjectivity and the ability to engage in reflexive practice. Additionally, changing beliefs and assumptions is likely to engage strong emotions and may be "an integral part of individual adaption and motivation" (Bierema, 2008, p. 62). Engineering culture is not typically known for valuing emotional work, plural views of knowledge such as objective and subjective or focusing on how social structures of race, gender, and class affect the politics of knowledge production in all disciplines, including in science and engineering. Finally, engineering culture is heavily influenced by a white middle class masculine paradigm and it is probable that a hidden curriculum exists that reinforces dominant values that are in conflict with diversity initiatives.

Purpose and Research Questions

Given the lack of data based research studies that focus on workplace learning and diversity perspectives that deal with race, culture, gender and age specifically in the engineering workplace, the purpose of this mixed method study is to investigate engineers' perceptions of diversity and the workplace learning environment surrounding diversity education efforts in engineering occupations. Particular attention will be paid to the intersection of gender, race, and age. Engineers' perceptions of diversity factors (factors that enhance organizational inclusiveness) in the work environment will be examined through a survey to determine if the positionalities of gender, race and age affect perceptions. In addition, the researcher will perform in-depth interviews, from a purposeful sub-sample of survey participants who are women, women of color, women aged 40 and under and women who are dissatisfied with their engineering work environment, to glean more insight as to the effect of the intersections of gender, race and age on perceptions of the engineering workplace. Although white masculine culture and structure have been identified as barriers to diversity, much of the past research focused only on the absence of women, particularly in the educational arena. Few studies have examined engineering using a feminist theoretical lens that specifically attends to issues of positionality and there is a definite lack of research focused on workplace learning in engineering workplaces. The specific questions that guide this study are:

1. To what extent do engineers perceive that engineering worksites foster learning about diversity issues related to gender, race/ethnicity and culture?
2. What are engineers' perceptions of diversity in engineering workplace culture?
3. Do interactions between gender, race and age influence engineers' perceptions of diversity in engineering organizational culture?

Theoretical Framework

The theoretical framework that guides this study combines critical and feminist adult education perspectives, informed by poststructural feminist theory, with Rasmussan's (2007) diversity mosaic perspective in organizations.

Rasmussen's (2007) *Diversity Mosaic* is a pragmatic model that combines multicultural theory with a strong connection to praxis in the business environment. The five cornerstones of this model are: (1) inclusive definition of diversity, (2) business case for diversity, (3) cultural competence scorecard, (4) diversity adoption curve, and (5) diversity enhancement process. Of these, only two are relevant to this discussion, the cultural competence scorecard and the business case for diversity. The cultural competence score card is the evaluation piece of the model and of particular importance to this research. It includes a measure of workplace culture that provides information about how inclusive people perceive their work environment to be as well as indicators of the organization's learning culture.

The culture climate instrument assesses five components that impact valuing diversity; (1) recruiting, (2) retention, (3) communication, (4) leadership, and (5) interpersonal climate. In addition to aligning organizational diversity with a social justice outcome, the business case explicitly articulates why creating a multicultural organization is necessary to corporate survival and how everyone in the organization will benefit. Without aligning diversity initiatives to the sustainability of the organization, it is likely that those in the dominant power group will have little motivation and quite possibly resistance making real change unlikely to occur. Because the diversity mosaic model combines theoretical concepts with practice oriented tools, includes a sustainable business model and uses a "nuts and bolts" (Rasmussen, 2007, p. xxi) approach, it is well suited for application in engineering and other workplaces where nuts and bolts approaches

are familiar and the dominant group is motivated more by rational business models than theoretical concepts of social justice. From a critical perspective, the purpose of the model is for organizations and their employees to become aware of unconsciousness acceptance of dominant culture and power relations. The model accomplishes this by promoting a less hierarchical, democratic workplace learning environment, an acceptance of the plurality of beliefs and ideas and an analysis of how organizational culture and structure affect behaviors. These tenets are supported by critical feminist perspectives informed by poststructural feminist theory.

As indicated, this research is also guided by the foundations of critical feminist perspectives informed by poststructural feminist theory, discussed to some degree earlier. In particular, three aspects of a poststructural feminist framework guide this study. First, a feminist poststructural theoretical view places importance on the positionality of people. Paying attention to people's positionality allows for an examination of how individual difference in areas such as gender, culture, race and socioeconomics, intersects with social structures and personal perceptions. The diversity mosaic model refers to this as dimensions of diversity. Second, poststructuralist ideology favors discourse deconstruction to examine the role of language in the reinforcement of truth assumptions that maintain dominant ideology and hegemony (St. Pierre, 2000). This concept will be investigated during the qualitative portion of the study. Third, attention is paid to the interrelationships between power relations, social structures, actions, discourse and individual's perceptions. The workplace climate survey contains several questions that address power relations and unequal social structures. In contrast to previous research that focused on numbers and female or minority characteristics as lacking rather than organizational change, critical analysis through a diversity and poststructural feminist theory lens aligns theoretical concepts to practice and may lead to an awareness of why and how inequality is

maintained and reinforced. Analysis of discourse and actions that reinforces dominant assumptions and the relationships, particularly the power circulation between individuals and social structures is vitally important for a number of reasons. Much of the previous research focused on the lack of women through a deficient model putting the onus on others to assimilate to fit into STEM (Phipps, 2007). Also, recent statistics point to a downward trend in STEM graduation rates overall suggesting that the traditional masculine STEM environment may no longer be compatible to contemporary men's lives (Koehler, 2008). Finally, by examining power relations, actions and discourse it may be possible to understand the role authority figures play in eliminating binary thought and creating/supporting inclusionary practices. In this way an organization can redefine others as a potential source of strength by fostering powerful oppositional knowledge (Collins, 1998).

Overview of Design and Methodology

The current study will make use of a mixed methods research (commonly called mixed methods) methodology that contains both quantitative and qualitative techniques. By using mixed methods this study, takes advantage of the benefits of having a wide data base of engineers' perceptions obtained through a quantitative survey of a large sample of engineers combined with some in-depth qualitative interviews that add richness and includes the voices of underrepresented populations (O'Cathain, Murphy & Nicholl, 2007). The design for this research falls in the sequential transformative type of mixed methods. In a sequential transformative design, a specific advocacy framework is used, either type of data may be collected and analyzed first, priority may be unequal or equal, and data analysis is connected and integrated at the end (Creswell & Plano Clark, 2007; Teddlie & Tashakkori, 2009). The quantitative piece will be implemented first and the data collected will serve to inform the qualitative design. In other

words, the qualitative findings can provide an understanding of the *why* identified by the *what* from the quantitative results (Hodgkin, 2008). Data analysis will be connected and integrated at the end. This choice is supported by a theoretical perspective of a critical diversity model and critical feminist perspectives including poststructual feminist theory, referred to as an advocacy lens, as a vehicle of change for the betterment of society. Frameworks with a critical theory perspective such as the multicultural theoretical basis used in this study tend to use both quantitative and qualitative methodological approaches. Additionally, mixed methods research is associated with a pragmatic world view that accepts theoretical pluralism in search of practical solutions (Creswell & Plano Clark, 2007).

The integration of the findings of the quantitative and qualitative data is also supportive of the research context. As a discipline, engineering places great value in rational, quantitative inquiry. A strong quantitative component that incorporates engineering discourse is important to appeal to this population. A workplace climate survey based on the *Diversity Mosaic* (Rasmussen, 2007) instrument will collect quantitative data that is designed to identify participant's positionality and their perceptions of the cultural and structural equity of engineering occupations. Six cultural climate factors are examined: recruiting, retention, communications, leadership, interpersonal climate and the learning environment. In an attempt to identify climate factors that correlate with job satisfaction, another factor, employee engagement is included. Responses are scored on a 1 (strongly disagree) through 5 (strongly agree) Likert scale. A question asking if participants are willing to take part in an interview is incorporated. An example of the survey can be found in the Appendix A. The analysis of the quantitative data will strongly inform the qualitative piece by providing the direction of the interview questions and assist in the selection of a subsample for the qualitative piece. The qualitative piece consists of semi-

structured, in-depth interviews. The purposeful sample will be selected using demographic data identifying women, women of color, women aged 40 and under and women who indicate they are not satisfied with the culture climate in their work sites and/or those who do not like their job. From those who indicate a willingness to participate in an interview, eight to ten engineers will be selected using the above criteria. The interviews will seek to gain an in-depth understanding of women, women of color, and younger women's perceptions of engineering culture climate. Although the survey results may highlight topics of specific concerns, the focus of the interview will be on areas that relate to positive attributes of a learning organization such as vision, empowerment, appropriate rewards, effective communication and trust (Gardiner, 1999). Additionally, the effect of the organization's culture on informal learning will be explored.

The sample frame for the survey instrument consists of the professional engineer (PE) data base from Pennsylvania. Available from the Pennsylvania Department of State, this data base contains the names and addresses of all the engineers who are licensed to practice engineering in Pennsylvania. The Pennsylvania PE data base was chosen because the researcher lives and practices in Pennsylvania and therefore has some geographic proximity to the sample population, an important consideration for the qualitative portion of the study. Additionally, there is a fee associated with obtaining professional engineering lists from states prohibiting the researcher from obtaining additional lists from other states. The Pennsylvania PE list contains approximately 37,000 records and provides engineers' names and addresses. The sample population will be selected from this group and the survey instrument will be mailed. A sample for the qualitative interviews will be selected following receipt and initial analysis of the quantitative data. A detailed discussion of the methodology, quantitative hypotheses, and sampling and mailing strategies can be found in Chapter Three.

Significance

Dominant ideology resulting in social inequality for large portions of marginalized populations is a reality in most societies. Frequently, work and educational environments are sites that reinforce dominant ideology and maintain a system of inequality and oppression (Kimmel, 2008). Social, cultural and structural issues create hostile environments, maintain pay inequalities and limit access to higher management positions for marginalized populations. This study is significant in its examination of the mechanisms that reinforce dominant ideology and assumptions in an occupation with a traditional white masculine organizational culture and structure. Through the perceptions and discourse of participants, this study may provide a better understanding of how learning culture and structure reinforce inequality and how positionality affects perceptions of exclusionary culture and structure. In addition, this research may add to the body of knowledge in workplace learning and multicultural theory, particularly in connecting theory to practice. It is also significant to the field of adult education as a means to promote a sharing of ideas and cross discipline research, particularly with the field of human resources. As discussed previously, workplace learning is currently being researched through a variety of disciplines and philosophical foundations that rarely inform one another. In that human resources and adult education have much in common, "What is needed is a bridge between adult education and human resource development, where scholars create stronger researched based theories, with practitioners being able to recognize greater collaboration and fewer areas of dissension" (Hatcher & Bowles, 2006, p. 6).

This study is personally significant for me as I am a woman with undergraduate degrees in chemistry and engineering who does not practice as a scientist or engineer. My personal experiences of being educated and working in white male dominated environments has caused me

to investigate a dominant culture that works to exclude capable and talented people to the point of its own detriment. By eschewing a career in engineering, in part because of a patronizing and unwelcoming masculine culture, I forfeited financial and professional recognition for personal and professional satisfaction. I am concerned that the traditional engineering culture sustains and supports social inequality prohibiting many talented and qualified people from fully participating and economically benefiting from a career in engineering.

Assumptions, Limitations and Strengths of the Research Project

All research carries inherent assumptions and limitations and the current research project is no exception.

Assumptions

The assumptions that are inherent in this research are: First, "In the United States, there is an overriding national context in which Euro-Whiteness, maleness, heterosexuality and middle class status are presumed normative and culturally imperative" (Lott, 2010, p. 6) and second, engineering culture is steeped in this national context. Third, those normative white male populations are privileged and suffer from the invisibility of their dominant status. Fourth, the lack of cultural competency in engineering is a factor in the underrepresentation of women and minorities. Fifth, in identifying cultural competency as a component of diversity initiatives, it is assumed that cultural competency is a learned behavior. Sixth, by critically examining engineering workplace culture participants will be able recognize dominant culture and structures that exclude other populations. Seventh, this study examines engineering workplaces as sites of learning and implies that the context of workplace learning is distinct from learning in other contexts.

Limitations and Strengths

All research has limitations as well as strengths embedded within the design and researcher and participant involvement. This proposed study has the following limitations: First, even though the survey encourages critical perspectives, dominant populations in engineering occupations may not recognize and acknowledge inequalities. Second, due to assimilation and coping mechanisms women and minorities in engineering occupations may not recognize and/or acknowledge inequalities (Jorgenson, 2002). Third, it is possible that a lack of diversity in the sample pool may require oversampling and/or a stratified sampling technique. Fourth, lack of a sufficient sample size may affect the statistical significance of the findings in examining intersections of gender, race and age. Finally, my experiences in the fields of science and engineering education may cause bias and influence either my analysis of the qualitative interview data or the qualitative participant's responses. As with all qualitative inquiry, my awareness of this possible bias and influence is extremely important. In spite of these limitations, the proposed study has some definite strengths. First, the mixed methods research paradigm offers the opportunity to gain an overall understanding of engineering occupation's workplace diversity/learning climate and through rich descriptions, provide voice from marginalized engineers. This could lead to a better understanding of the issues non-traditional engineers' experience. Second, the use of a critical theoretical framework designed to uncover issues of structural inequality, workplace hegemony and patriarchy may cause engineers to critical reflect on workplace diversity and become aware of social and structural inequalities, ultimately leading to structural and external social change.

Definition of Terms

1. Acculturation – "the way cultural differences [and/or multiple positionalities] are handled when parties from different cultural traditions are merged into one group" (Cox, 2001, p. 66).
2. Advocacy framework– a social change oriented view based on the ideals social justice
3. Affirmative action – Policies that promote equal opportunity for all; specific actions taken to increase the participation of women and minorities in areas where they are typically underrepresented through exclusionary practices.
4. Assimilation – "when norms, values, and beliefs of the stronger, more dominant party or group are imposed on other less powerful parties" (Cox, p. 66).
5. Critical theory - An approach to analyzing society that does not accept positivist value-free assertions, but seeks to analyze social structure and systems that are socially constructed and result in oppression and valuing certain members of society and knowledge over others.
6. Critical Race Theory – Applying critical theory to the particular social construction of race by analyzing social structure and system that result in oppression and valuing certain races over others.
7. Culture – "Socially transmitted beliefs, values and practices…such as shared distinctive behavior norms that may appear natural…" (Lott, 2010, p. 11).
8. Diversity - "The mosaic of people, who bring a variety of backgrounds, styles, perspectives, beliefs and competencies as assets to the groups and organizations with whom they interact" (Rasmussen, 2007, p. 1).

9. Diversity Management – Policies and practices that encourage the participation of all persons.
10. Essentialism – Ascribing properties or behavior to biological origin and assuming that groups of people who are socially categorized or differentiated (for example women and African Americans) universally exhibit those properties.
11. Ethnocentrism – "Preference for members of one's own "in-group" (Cox, p.67).
12. Homosocial – "of, relating to, or involving social relationships between persons of the same sex and especially between men" (2009).
13. Marginalized populations – People who are disadvantaged, socio-economically due to their positionality.
14. Neo-conservative globalization – A view that "constructs the world as a seamless market for the movement of the goods, services, finances, and labor for the maximizing of profits" (Kell et al., 2004, p. xvii).
15. Inclusive environments – Cultures and structures that respect and value people's diverse positionalities.
16. Pluralism – Where "each party is open to movement toward the culture of others, the best traditions of each culture are carefully considered for adaption by the total enterprise, and each party retains some of their identity" (Cox, 2001, p. 66).
17. Positionality – A person's standpoint in terms of gender, race, age, life experiences, socio-economic position, sexual orientation, etc.
18. Poststructural Feminist Theory –Poststructural feminism rejects fixed identities, highlights positionality with the notion that it is constantly shifting and examines power relations

through action and discourse and authoritative figures' actions in negotiating those relations.

19. Social Justice – Social, legal and economic equity for all regardless of their positionality.
20. Sustainability – Development that meets the needs of the present while not compromising the needs of the future.
21. Workplace Learning – "…human change or growth that occurs primarily in activities and contexts of work…" (Fenwick, 2001, p. 4).

CHAPTER 2: REVIEW OF THE LITERATURE

The purpose of this chapter is to explore the literature that informs a mixed methods research study investigating engineers' perceptions of diversity and the workplace learning environment surrounding diversity education efforts in engineering occupations. The primary research questions are: "To what extent do engineers perceive that engineering worksites foster learning especially about diversity issues related to gender, race/ethnicity and culture?", "What are engineers' perceptions of diversity in engineering workplace culture?" and "Do interactions between gender, race and age influence engineers' perceptions of diversity in engineering organizational culture?" In researching the issue of diversity in engineering worksites, three bodies of literature are pertinent. The first body of literature addresses the theoretical framework that guides the current study; a combination of critical and feminist adult education perspectives, informed by poststructural feminist theory, and organizational diversity theory. The second body of literature discusses adult learning in the workplace and the last literature review focuses specifically on underrepresentation in engineering. The following section will discuss the interrelated concepts that guide the current research study.

Theoretical Framework:

Critical and Feminist Adult Education Perspectives and Organizational Diversity

The theoretical framework of this study is grounded in critical and feminist adult education perspectives, informed by poststructural feminist theory and organizational diversity theory, particularly for what it might suggest for understanding engineers experiences around learning about diversity in the workplace. This section begins by laying out the theoretical grounding of poststructural feminist theory, and then discusses some of the theory around organizational diversity.

Poststructural Feminist Theory

In general terms, feminist theory is defined by an attention to inequalities based on gender roles and behaviors with the ultimate goal of achieving gender equality (Chafetz, 1999). Some theories emphasize the role of gender role socialization in an individual's consciousness more from a psychological perspective which informs thought and behavior. Other structural feminist theories emphasize the role of organizing social structures such as gender, race, or social class and how they act as systems of privilege or oppression. However, various theories, including poststructural feminism, question the validity of feminist perspectives that rely on individual psychoanalytic and humanistic analyses that can inadvertently reinforce binary opposites, such as "men are this, women are that", or universal meanings and intellectual categories.

Poststructural feminist theory is reflective of this paradigm shift from modernism to postmodernism. Modernism, an outgrowth of the Enlightenment tradition, is characterized by a belief in a universal human essence and experience that is defined by human nature and a neutral truth that can be achieved through scientific reasoning (Lather, 1991, 1992; Hartsock, 1996; St. Pierre, 2000). Modernism, also emphasizes a belief in objectivity, and tends to view the world in terms of stable categories, where dichotomous categories (such as women/men, black/white, oppressed/privileged) are clearly defined. To some, extent structural social theories, such as Marxism or Marxist feminism, that focus attention on social structures (such as gender, or social class) as clear categories that structure power relations in society, arise out of a modernist understanding of the world. Such theories tend to give little consideration to the differences within groups, the shifting identities that individuals experience and the role individuals and self agency play in maintaining or subverting the dominant paradigm (Tisdell, 1998).

In contrast to modernism, poststructural feminism challenges the notion of binary opposites, while acknowledging that power relations and inequality shape an individual's identity, but that individuals also act with agency in their own lives. By examining social constructions of individual identity that are informed by positionality (or the social structures of race, gender, or class that affect where one is positioned in society) and impact knowledge construction, poststructural feminist theory acknowledges the connections between individuals, their positionality, and social structures with an attention to power relations and discourse (St. Pierre & Pillow, 2000). As such, a poststructual feminist perspective contains a fundamental belief that all knowledge, including scientific knowledge is subjective knowledge to some degree, in that its creation is shaped to one extent or another by multiple beliefs. Poststructuralism's tenants of examining interactions between social structures and individuals (who view the world through complex and shifting positionality), deconstructing discourse and binary thought, and examining the role of power relations can lead to a better understanding of how inequality and oppression is either challenged or maintained.

Positionality and discourse. Feminist poststructuralism highlights issues of positionality and discourse. First, a feminist poststructural theoretical view places importance on the positionality of people. Paying attention to people's positionality allows for an examination of how individual difference in areas such as gender, culture, race and socioeconomics, intersects with social structures and personal perceptions. In other words, how people perceive the connections between themselves, social structures and their work environment is affected by the position they occupy in life (English, 2006; Tisdell, 1998). Second, by examining the role of language in the reinforcement of truth, discourse deconstruction seeks to uncover assumptions, often reinforced by natural or truth statements that maintain dominant ideology and hegemony

(St. Pierre, 2000). Third, attention that is paid to the interrelationships between power relations, social structures, actions, discourse and individual's perceptions acknowledges the complexity of social systems that maintain inequality. In contrast to previous research examining inequality in organizations that primarily focused on the number of women and minorities and/or implied women and minorities as lacking certain desirable characteristics, this type of analysis may lead to an awareness of why and how inequality is maintained and reinforced with the outcome of promoting organizational change. Thus using a critical and feminist adult education framework that is informed by poststructural feminist theory is very useful in understanding individual's perceptions of organizational practices and cultures that include or exclude the positions with which they self identify.

For example, influenced by Foucault (1984), poststructural feminism examines discourse in an effort to uncover language that reinforces binaries and truth statements that support dominant ideology. Meaning is created through language, frequently through the use of binaries and therefore those who create the discourse are in effect creating meaning. Typically these constructed binaries such as "mind/body, rational/irrational, subject/object" (St. Pierre, 2000, p. 481) result in hierarchical operations that advantage the dominant class. With reference to Habermas' theory of communicative action, a concept that posits rationality as not within the realm of reason or knowledge but within the sphere of language, discourse is deconstructed to examine rational impact with an emphasis on power (Allen, 2005; Qin, 2004; Rosser, 2005, Welton, 1995). Analysis and deconstruction of discourse and the meanings associated with it can uncover the subjective nature of reality revealing issues of power and how dominant ideology is reinforced or refuted through language (Tisdell, 1998). Poststructuralism's attention to deconstructing the mechanisms of discourse and binary thought can result in an understanding

of how power relations support or inhibit inequalities. This is particularly important in societies where women and femininity are frequently on the disadvantaged side of the hierarchies that binary discourse and thought produces. For example in the binary rational/irrational, rational is associated the masculine while irrational depicts the feminine. To demonstrate how these socially constructed binaries affect social systems, consider that rational would also be used to describe the field of engineering reinforcing engineering as a masculine endeavor. Statements that identify characteristics of engineers such as, "Engineers are rational" serve to reinforce the masculine culture given that the patriarchal grand narrative reinforces this binary *truth* that imprints men as rational and women as irrational/emotional. In addition, instead of questioning assumptions about engineers and engineering culture, dominant discourse provides an appropriately *rational* explanation for why women are underrepresented in the engineering field; all women share an essential irrational, emotional nature that is not consistent with the rational endeavor of engineering. Poststructural feminism discourages essentialist and binary thought by recognizing that within the identity of men and women, different positionalities result in diverse perceptions, power relations, meanings and interactions with structure.

Deconstruction of categories. Another foundation of poststructural theory is that the positions people occupy and the meaning that they derive from those positions, including gender roles, are socially constructed and are shifting and unstable (Lather, 1991, 1992; St. Pierre, 2000; Tisdell, 1998); thus poststructuralism emphasizes the instability and deconstruction of fixed categories, including of identity categories. The concept of a fixed and essential identity is reframed by this notion of positionality that acknowledges each person's uniqueness, ever changing identity and self agency. It follows that as people's positionality shifts the meaning they make is also fluid. Therefore, a poststructural awareness of plurality and changeability of

life leads to an acceptance of multiple sources of knowledge, methodologies and viewpoints allowing for the possibility to study phenomena from many different perspectives. For this reason, poststructural viewpoints critique analyses that create groups and classifications as points of reference and a means of ordering (and making meaning of) observations. These critiques focus on attributing universal essences to categories; that biological qualities are the source of social inequality instead of acknowledging structure and socially constructed categories as agents of oppression (St. Pierre, 2000). For example, the lack of women in STEM fields has long been attributed to women (as a group) lacking the level of analytical and mathematic ability as their male counterparts. Even though research has not found conclusive evidence to support the hypothesis that women lack such ability (and that this lack is responsible for women not entering STEM fields), this gendered ideology persists through dominant discourse that reinforces the *natural* aspect of male dominated spaces. Additionally, the narrative of men being *better* at science, math and analytical reasoning remains despite consistent reporting is that there is greater variability among men and among women then between men and women in regards to mathematic ability (Ceci & Williams, 2007; Kimmel, 2008; Lott, 2010). The question then becomes, who benefits from this dominant ideology and how does it persist?

Power relations, identity, and agency. Poststructural feminist theory also emphasizes both the importance of power relations in shaping identity and an individual's agency or ability to make choices. This critical examination of how individuals perceive power relations and the connections between themselves and social structures distinguishes poststructural feminist theory and allows for the possibility of self agency and social change. By examining authoritative figures' power relations, actions and discourse it may be possible to understand the role authoritative figures play in eliminating binary thought and creating/supporting inclusionary

practices. In deconstructing discourse, structures and power relations, new perspectives and realities are uncovered which in turn are questioned and examined in a continuum of deconstruction and reconstruction (St. Pierre, 2000). Little research in underrepresentation in engineering has used a poststructural theoretical lens (Tsai, 2003) resulting in a lack of understanding about the significance of the interaction between the individual and the structural and even less is known about the affects of positionaility.

As indicated previously, in addition to gender, poststructuralism attends to power relations and positionalities that include, among others, race, ethnicity, age and socio-economic status. This awareness of multiple sites of oppression and how they interact with each other is sometimes referred to as the intersection of race, class and gender (Chafetz, 1990; Collins, 1990; Holvino, 2001). The concept of intersectionality is a powerful albeit complicated response to the criticism that feminist theory universalized the experiences of white, middle class women. Because it pays attention to the complexity of processes such as structure and socially constructed categories when examining how inequalities are produced, the intertwined production of inequalities and identities are made visible. Very little, if any, research has focused on the concept of positionality intersectionality in engineering. However, speaking in terms of intersectionality is difficult "because it is not clear how to break down the boundaries of reified categories to show how multiple inequalities are simultaneously reproduced. Each categorical name—e.g., gender or class—represents complex and highly variable social relations, usually simplified as sub-categories—e.g., masculine and feminine or middle class and working class" (Acker, 2006, p. 446). Other critiques of poststructural feminist frameworks point to the incongruity of examining structures and categories that by poststructural standards are not valid or do not exist.

Critiques, applications, and conclusions. There are critiques of poststructural feminism as well as applications that are helpful to lay out here for why it is of benefit to use this frame for this study. Criticisms of poststructural feminism include the lack of clarity that results when categories are abolished and claim that upon deep examination it is a theory that falls apart under its own scrutiny (St. Pierre, 2000). Poststructuralism's concept of moving identities and boundaries defies any attempt at definition; "asking essentializing questions about the 'meaning' of anything" (St. Pierre, p. 485) is seen by some as rendering it irrelevant. Some feminists' concerns center around the loss of political influence when the category of women is deconstructed (Butler, 2001), arguing that it is difficult to organize a project of social change around the category "woman" if one calls into question the category itself. Although some feminist advocate using the *false* category of women to advance a political agenda, many reject that notion indicating that such language will ultimately serve to reinforce existing binaries and ingrained assumptions of normality (Butler, 2001). In addition, not naming the category of woman as problematic reinforces the legitimacy of the category of men, ignoring the ways in which men are oppressed by hegemonic masculinity (Bryson, 1999). These are the more typical critiques of feminist poststructuralism.

While some of these critiques are reasonable, a poststructural feminist lens is still very useful. Recognizing that variation of experience and identity construction exists between women (and men as well) and that individual identity is subject to change is particularly important in the current study. It brings to the table is a different set of questions such as "How does discourse function to reproduce inequality?" "Who benefits from these socially constructed binaries and systems?" and "What is the role of power in reproducing and regulating social norms?" Asking these types of questions can also uncover a problematic universal masculine narrative which

leaves many men on the margin (Kimmel, 2008). In support of a poststructural viewpoint, despite the acknowledged difficulties, St. Pierre (2000) states, “Our ability to rest in ambiguity and possibility...is a poststructural practice of freedom as is the critique of the signifiers that limit our imaginations” (p. 505).

Although poststructural feminist theory has found primary application within feminist research, because of the attention to plurality, positionality, discourse and power there is also a contemplation of practices that are considered democratic and inclusionary including group work, interdisciplinary work environments, acknowledgement of power relationships, transparent agendas and the encouragement of dialogue (English, 2006). Democratic and critical practices are not specifically focused on the inclusion of women, but seek to create an atmosphere of equal participation and respect for all people, regardless of their positions in life. Since inclusion issues in engineering have too often examined women from a deficit model that encouraged essentialist thought (ie, men are this, women are that) and served to reinforce binary discourse, an examination of workplace practices through a poststructural lens that identifies democratic practice could prove useful in uncovering structures that are inhibitory. In addition, focusing on women contributed to the invisibility of minority populations that are also underrepresented in engineering (Koehler, 2008). Finally, with recent statistics pointing to a downward trend in engineering graduation rates overall (earned bachelor degrees dropped by 22% since 1985) (Gibbons, 2007), an investigation of the seemingly incongruous relationship between current traditional masculine engineering culture and contemporary demographics and social changes in male and female roles seems appropriate. Examining the issue of underrepresentation in engineering using a framework that includes people’s subjective realities and experiences while deconstructing the dominant discourse and power relations may lead to

greater understanding of why engineering has proved so resistant to workforce diversification (Phipps, 2007). With this discussion of feminist poststructuralism as a background, the following section examining diversity organizational theory helps situate the study more specifically in an organizational setting.

Organizational Diversity in a Multicultural Context

To situate the organizational diversity model used to guide the current study, a historical perspective of multicultural theory is helpful, particularly in regard to education, to consider how this has been applied in organizational settings.

Multicultural education theories. In the 1960s and 1970s multicultural educational theory emerged in response to a number of social pressures; the civil rights and feminist movements and an increasingly diverse population in the public school system. In an effort to address ethnic and culturally diverse classrooms, multicultural education initiatives flourished (Resnick, 2009). A commonly stated goal of multicultural education is that of providing people the tools to participate in a democratic society that provides inclusion for all its citizens (Banks, 2004). However, in spite of a diverse social reality including differences in race, culture, socioeconomics and gender, educational practices and policies in the United States often reflect white middle class male Eurocentric ideology. This dominant ideology, a set of common values and beliefs shared by most people in a given society, reflects, or serves, the interests of the dominant class in that society (Brookfield & Preskill, 2005). So while social and demographic change prompted an examination of the purpose of education that propelled educational theorists towards development of multicultural theories, pluralistic democratic societies continue to struggle with balancing issues of diversity and unity; embracing and celebrating diverse cultural background while promoting the ideals of a larger society (Banks, 2007).

Multicultural educational models are defined by underlying philosophical assumptions, purpose and praxis that resulted in multiple definitions and approaches. In general, multicultural educational models tend to be hierarchical and focus on race/ethnicity and/or gender. The approaches generally range from prompting an awareness of others (meaning those other than white middle class men) by adding diverse material to the curriculum, which does not fundamentally change or challenge the dominant culture of that curriculum, to a social justice model with the goal of social change by questioning and examining dominant ideology (Banks, 2002; Banks, 2007; Hanley, 1999; Sleeter & Grant, 2009). In practice, most multicultural initiatives used an additive approach by acknowledging the occasional female hero or African American holiday which resulted in leaving the master narrative unchallenged. It can be viewed as similar to a female "deficiency model" (p. 46) that assumes students are lacking or a "difference orientation" (p. 52) that acknowledges and values cultural difference and holds pedagogy responsible for students' success or failure. As it is based on "help[ing] fit people into the existing social structure" (Sleeter & Grant, p. 44), teaching from an additive or culturally different perspective has a philosophical orientation based on assimilation. Assimilation ideology embraces a pedagogy that teaches minority groups to fit into dominate ideology and culture. In the extreme, assimilation is acceptance, without reservation, by the dominant culture (Manicas, 2007).

Assimilation, a process whereby the *other* gives up individual characteristics (language, culture, values and behavior) and adopts those of the dominant group (Banks, 2002) is seen by many as the primary vehicle to reconcile diverse populations. Assimilationists also assume the values, culture and characteristics of the dominant group are superior, right, and true. In theory, it is based on an idea of mutual benefits; as minorities assimilate dominant culture ideals, they gain

equality and benefit financially and socially. This is reinforced in the mythological American dream grand narrative; if people work hard, their efforts will be rewarded. As well, society gains from all populations participating with plural voices and ideas, in the democratic process. However, as Baldwin (as referenced in Banks, 2007, p. 4) asserts, "What society really, ideally, wants is a citizenry that will simply obey the rules of society" (p. 326); rules that are created by and reflect the privileged dominant perspective. Assimilation has little in common with poststructural feminist theory and social justice models by ignoring underlying power and structural imbalances that support a view of dominant culture as superior and the norm, resulting in a homogeneous society void of critical analysis (Banks, 2007; Hanley, 1999). In the worst case scenario, assimilation of dominant culture and behaviors can lead to deculturation or a cultural void where a person is distanced from the culture of their birth but can never be fully accepted by the dominant culture (Banks, 2002, 2007; Ladson-Billings, 1995; Manicus, 2007). As will be discussed in the inequality in engineering literature, women's need to assimilate is a major theme and identified as a barrier in creating a climate of inclusion in engineering. From another perspective, multicultural educational initiatives have also been attacked by neoconservative forces. With a focus on excellence, accountability (teaching to standardized tests) and global competitiveness, neoconservatives implicate multicultural pedagogy for being partly responsible for lowering educational standards and enhancing the separatism of minorities (Resnick, 2009).

Organizational diversity. The multicultural education efforts paved the way and informed organizational diversity efforts. While civic multiculturalism (education to prepare the citizenship to fulfill the ideals of democracy) in some of its manifestations has been heavily criticized, multicultural interest (most commonly called diversity) in the area of business and

management is increasing (Resnick, 2009). Initially fueled by the publication of *Workforce 2000,* a report that forecasted drastic changes in the labor market due to an increase of women and minorities in the workforce, many organizations implemented diversity initiatives. As with multicultural educational theory, organizational diversity initially took the form of diversity workshops and relied on educational perspectives of additive and celebrating diversity approaches or relied on affirmative action perspectives that examine the representation of women and minorities within the organization. And as with multicultural educational models, these initiatives often failed producing little or no organizational change. Some theorized that a lack of theoretical grounding in critical paradigms ignored individual and structural interactions; therefore diversity did not become embedded in the organizational culture (Cox, 2001). Other criticisms of earlier organizational diversity initiatives include lack of evaluation, organizational commitment, misunderstanding the type of learning involved (affective versus instrumental) and a focus on minorities that alienated dominant groups (Cox, 2001; Rasmussen, 2007; Resnick, 2009).

For example, diversity initiatives that are perceived as applying only to the minority group members often fail. The "colorblind approach" (Resnick, 2009, p. 120) falls into democratic discourse and melting pot ideology that encourages membership in the organization through assimilation and minimizing difference for the good of all. The approach fails to examine ideology and structure that favors majority members and excludes minority populations. "Multicultural approaches" (Resnick, p. 120) recognize employee differences and may institute diversity days where employees from diverse backgrounds are celebrated through programs and/or luncheons that focus on different aspects of others' cultures. Similar to *celebrating differences*, this approach often fails because of non-participation, resentment and resistance

from the non-minority group. Majority groups frequently see the colorblind and multicultural approaches as threats to their way of life and their dominant cultural identity while minority groups see them as superficial without creating organizational change. More recent organizational diversity literature shows signs of critical and poststructural theoretical influence.

Since 2000, the literature on organizational diversity has increased (Stevens, Plaut & Sanchez-Burks, 2008). Many organizations have come to the realization that it is no longer realistic or economically productive to maintain an organization with an all-white/all-male work force, particularly in a global market environment where many companies are internationally or multi-nationally owned with locations throughout the world. The current organizational diversity literature reflects a switch from conceptualizing knowledge as "static and neutral to socially constructed and dynamic" (Banks, 2007, p. 15) and outcomes that focus on fairness and equal opportunity, instead of for everyone to be treated the same. Usually, systems, structures, practices are considered normal or neutral but reflect the values and life situations of the people who created the organization. While the *way things are* may be natural to those who share a dominant culture, someone who is not part of that culture will not find them common. Giving privileged status to some ways of working and learning inevitably results in the undervaluing of alternative ways (Buchanan, 2000; Raelin, 2000). Approaches that maximize inclusion and minimize resistance recognize and acknowledge the importance of not just racial/ethnic/gender difference but *all* demographic divergence as well as the interactions between the individual and the structural.

However, an increase in literature on workplace diversity is not reflected in the availability of research based articles focused on the development of instruments that measure workplace culture climate and identify factors that relate to diversity (DeMeuse & Hostager,

2001, Turnbull, Greenwood, Tworoger & Golden, 2009). Although evaluation of workplace climate or culture climate through a quantitative instrument is becoming more common, most surveys are a function of human resource and/or are contracted out to diversity consultants. Beyond identifying a need for diversity measurements and indicating that those measurements should be customized to the context, the number of research studies that focus on the actual instrument development, including evaluation and reliability is small (DeMuse & Hostager, 2001; Ioannou, 2008; Murphy; 2005; Vactor, 1999). Four research studies that focused on workplace culture climate and survey development were reviewed (Davis, 1998; Ioannou, 2008; Murphy, 2005; Vactor, 1999). These will be discussed in more detail in Chapter Three.

Vactor's (1999) thesis describes creating a culture climate survey for an institution of higher education and identifies several factors for measuring the culture climate. Davis (1998) reported on a workplace climate survey she developed relating to nurse managers' perceptions of diversity. Ioannou's (2008) diversity satisfaction scale included a factor analysis that identified three factors related to workplace climate, recruit and retain, climate for diversity, education for diversity. Murphy (2005) developed a survey examining the perceptions of effective workplace diversity in the non-profit sector. After factor analysis, she identified three significant factors related to workplace climate, organizational disposition to diversity, tolerance to interpersonal relations, and attention to diversity at the individual level.

Poststructuralism meets the diversity mosaic. Current models of organizational diversity incorporate critical and poststructural concepts to address the criticism of assimilation and excluding non-minority groups through inclusive initiatives that: (1) broaden the definition of diversity; (2) include poststructural feminist concepts of positionality (diversity dimensions); (3) critically examine leadership roles and discourse (communication); and (4) make diversity an

integral and ingrained part of the organizational structure. Most organizational diversity models also explicitly articulate the need to demonstrate the *business case* for creating diverse organizations. If organizations hope to engage employees in the change effort, leaders must make a clear connection between these new ways of doing business and improved business outcomes. People must understand that *valuing diversity* is demonstrated through real business behaviors and that engagement in these behaviors is part of their employment contract. Although some may perceive diversity through a social justice lens as *the right thing to do,* tying diversity initiatives to the financial solvency and long-term sustainability of the organization provides another point of inclusion for those who do not see diversity as a social responsibility. Organizations that view diversity through a critical and poststructural perspective are characterized by attention to practices such as: recruitment and retention practices that attract and retain talented and diverse employees, encouragement of open communication and ongoing learning, leaders who are models for valuing diversity and whose discourse matches their behavior, minority and majority groups participate at all levels of the organization, internal and external communications use inclusive language and horizontal management structures allow employee participation in decision making (Cox, 2001; O'Mara & Richter, 2009). *Paying attention* to these types of practices includes researching, analyzing and measuring them. Workplace culture climate assessments evaluating the business case and paying attention to the presence of diverse employees at all levels of the organization are attempts at evaluating diversity initiative (Cox, 2001; O'Mara & Richter; Rasmussen, 2007).

Discussed in detail in Chapter Three, the particular diversity model used for the proposed research (Rasmussen, 2007) attends to five cornerstones that make up a diversity initiative: (1) inclusive definition of diversity, (2) business case for diversity, (3) cultural competence

scorecard, (4) adoption curve, and (5) diversity enhancement process. In this context diversity is defined as "the mosaic of people, who bring a variety of backgrounds, styles, perspectives, beliefs and competencies as assets to the groups and organizations with whom they interact" (Rasmussen, 2007, p. 1). In recognizing that diversity is not simply related to race or gender, this definition is an attempt to include individual's diversity dimensions, a concept that is similar to poststructural feminism's attention to positionalities. Of import to the current research is the cultural competence scorecard that among other things measures workplace climate (through a survey tool) attending to the categories or factors discussed earlier; recruiting, retention, communication, leadership and interpersonal climate.

In practice, translating the theoretical concepts of poststructural feminism to a business model that includes concrete evaluation is difficult. The current study is an example of the paradox of being guided and influenced by a theoretical foundation that, at the very least, implicates category designation and categorical analysis as essentialist and responsible for promoting behaviors as natural but at the same time uses a quantitative methodology that relies on categorical analysis. In part, due to the limitations of knowledge about human development and the myriad of unknown factors that may influence people's perceptions, the overwhelming amount of data that would result in recognizing individual differences in human beings, and the accepted reliance on sample sizes that carry statistical significance, by necessity, quantitative research resorts to categorization. However, the current survey does contain questions that attempt to uncover the role of power, structure, leadership and discourse in diversity initiatives and broad demographic information is collected in an attempt to pay attention to positionaility. Among the modifications was the addition of a learning environment factor designed to measure the workplace learning climate in areas such as equal access to professional development, the

value placed on objective versus subjective knowledge and formal diversity training versus informal learning from mentors, observations and experiences. This apparent theoretical disconnect is addressed more fully in the discussion in Chapter Three of the usefulness and pragmatic application of a mixed methods research paradigm. The next section examines the topic of workplace learning.

Workplace Learning

Workplace learning is of concern to various groups such as adult educators, human resource development professionals and organizational management professionals. In the current study, it is important to pay attention to how engineers learn about diversity in the workplace. Questions such as: "Do engineering worksites support formal diversity training?" "Is the corporate rhetoric in line with formal training objectives?" and "Do every day practices reflect a value for diversity?" can provide an understanding of majority and non-majority participation in diversity learning. In engineering, are non-majority groups learning diversity means assimilation while the majority group sees diversity through an affirmative action lens? Additionally, information about what type of learning is valued and recognized, whether formal training to gain instrumental knowledge or informal on the job learning that can occur through observation and mentoring relationships, is important in looking at *who is learning what*. Engineering mentoring relationships are seen as important avenues of "learning the ropes" (Kowtha, p. 68) and acquiring social knowledge and job skills. However, lack of availability of mentors and role models is cited as a frequent cause for women not entering or not persisting in STEM (Hult, Callister, & Sullivan, 2005; Monhardt, Tillotson, & Veronesi, 1999; Phipps, 2007). In missing these learning opportunities are women learning that they do not belong in engineering?

Although adult educators describe workplace learning as an "intensely personal" activity (Merriam, Caffarella & Baumgartner, 2007, p. ix**)** that occurs within a "social system" (Bierema, 1996, p. 22) professional development has traditionally been under the purview of human resource departments and approached through a scientific lens (Taylorism) for the purpose of acquiring instrumental knowledge through objective instruction. Additionally, workplace learning is usually perceived as professional skill development within a classroom or structured environment (formal learning) for organizational gain or "effective performance is determined by measuring the value added to the [short-term] corporate bottom line" (Dirkx, 1996). Although it is beyond the scope of this review to examine the political debate surrounding adult learning, adult education and human resources, it is interesting and relevant to note that the differing philosophical foundations of adult education and human resource practitioners reflect the philosophical divide between adult education and engineering as well. Also, these foundations are important to understand because organizations, including engineering, have typically relied on a human resource model for professional development activities including diversity training.

Adult educators are typically interested in critical perspectives that support a social justice paradigm through individual development and awareness of social and structural oppression. In recognizing categories such as gender and race as socially constructed and occupations as political sites that support oppressive practices, adult educators also view knowledge as subjective and dependent on people's positionalities. As mentioned previously, human resource development generally views knowledge as an objective construct, work environments as neutral and professional development as a means to improve productivity through formal learning experiences. These traditional human resource development

perspectives have not proven successful in understanding the experiences of non-majority groups or for implementing organizational diversity initiatives since, among other reasons they lack critical frameworks that "challenge institutional oppression…the nature of structural conflicts and sharing of power" (Brooks & Clunis, 2007, p. 232), fail to examine interactions between workplace learning and individuals' positionality and ignore informal workplace learning. For the purposes of this discussion, informal learning in the workplace includes activities such as mentoring, networking, asking questions, feedback and learning through observation and participation (Berg & Chyung, 2008).

In general, research in workplace learning with a critical theoretical foundation is absent (Brooks & Clunis, 2007; Fenwick, 2008; Gedro, 2006). As with the literature on underrepresentation in STEM, most of the adult education literature on workplace learning has tended to adopt an "identity politics view" (Fenwick, 2008; p.24) with a strong focus on gender. This perspective excludes an understanding of the effect of intersecting positionalities such as gender, race, ethnicity and sexual orientation. Thus the literature gap highlights a need for critical workplace learning research that pays attention to individuals' positionality, structure and power; "who controls learning and who controls knowledge production in the workplace" (Shied, 2001, p. 125) (Bierema, 2009; Fenwick; Gedro; Howell, Carter & Schied, 2002; King & Biro, 2006). Additionally, recent human resource development scholarship has begun to question the one dimensional view of workplace learning as formal, rational, objective and neutral and cite a need for the field to adopt critical perspectives (Bierema; Fenwick, 2004). The workplace learning research-based literature that does explicitly attend to one or more aspect of positionality (gender, race, ethnicity, sexual orientation, etc.) includes the following major

themes: the influence of an organizations' structure on organizational change and learning; inconsistent organizational rhetoric versus practice; and barriers to success.

Abrahamsson's (2001) qualitative study examining gender-based learning in manufacturing found that organizations that were hierarchical and defined by strongly segregated gender norms (women's work and men's work were clearly defined) were less successful than those with insignificant gender typing and segregation in organizational change related to equal opportunity and individual learning. Additionally, men were more likely to participate in professional development, particularly when those learning opportunities were a prelude to advancement. The author suggests that without integrating change into the organizational structure, employees will engage in a variety of strategies ("restoration mechanisms", p. 305) to maintain the status quo. In other words when differences between what organizations *say* and what they *do* exist, positive development of the organization and workers is inhibited and gender inequality is maintained. Mojab and Gorman's (2003) review of the literature on the *learning organization* also examined the issue of contradictions between espoused philosophy and practice. Using a Marxist-feminist framework they critique the widely circulated concept of learning organizations as providing equal opportunity, being conducive to learning and encouraging employee empowerment. Although learning organization literature frequently appropriates social justice language, the reality is often heavier workloads with little opportunity for training and advancement in the lower work sectors, typically occupied by women and/or those of lower socioeconomic status.

Similarly, a qualitative study that used a critical and feminist theoretical framework explored the experiences of women in the workplace and workplace training (Howell, Carter, & Schied, 2002). The researchers concluded that in contrast to generally accepted assumptions,

organizational change from a hierarchical structure to a flatter management structure did not result in employee empowerment but had the effect of increasing the work load for those in lower paying positions – typically women. Additionally the training that women received was not helpful in building their careers and advancement, but focused on behavior changes that would benefit the organization such as being flexible and not being a "negaholic" (p. 119).

One quantitative study (Berg & Chyung, 2008) of workplace learning examined factors such as gender, age and organizational learning culture as influences for informal workplace learning. The results indicate that neither the learning culture or gender and educational level have an effect on informal learning engagement. They found the factor that most significantly impacted an individual's informal learning was the level of their interest in their profession. Berg and Chyung was the only study that explicitly discussed the significance of informal learning in the workplace and presented informal learning as a positive attribute where individuals engaged in informal learning to improve themselves. It is conceivable that informal learning is significant in situations where the corporate line and the everyday practices are in conflict and functions to maintain the status quo. Although the "tacit nature" (p. 240) of informal learning makes it difficult to study, lack of attention to privileged formal (an intentional structured presentation of educational material for the purposes of knowledge acquisition) and hidden informal learning (not structured or controlled learning) ignores the workplace as a political institution where hidden curriculum may function to reinforce or critique formal learning objectives. Indeed many groups may engage in informal learning as means of learning how to negotiate in organizations where they are the non-majority (Gedro, 2006).

A qualitative study by Barrett, Cervero and Johnson-Bailey (2003) illustrates this point. They examined the career development of black human resource professionals; these

professionals indicated “tacit understanding” (p. 111) was an important factor in knowing what was expected of them in work situations. The study also examined biculturalism strategies that helped black professionals exist in different sociocultural environments. These included support systems such as black human resource organizations and mentors. While white male mentors have been identified as more helpful in professional advancement, the respondents indicated they were more comfortable with black mentors in an informal relationship. In spite of support systems and corporate rhetoric valuing diversity, unfavorable conditions still exist. The study participants identified lack of role models, discrimination, lack of recognition based on meritocracy and the need to assimilate as barriers to their success. Similarly, a qualitative study (Palmer & Johnson-Bailey, 2005) focused on African Americans in training and development found that lack of diversity in the workplace, existing “good old boy” (p. 12) networks and lack of mentoring as major barriers in their career development. This study was grounded in a multicultural/diversity framework and concluded that despite diversity initiatives “organizational culture and structural, attitudinal and personal barriers continue to be formidable impediments” (p. 11).

Finally, a meta analysis of the research and literature on race and ethnicity in workplace learning by Brooks and Clunis (2007) found that while discussion of obstacles such as lack of mentoring and assimilation is common, research with critical frames is lacking. Because of this, analysis of the complexity of the interactions related to race and ethnicity in the workplace around structural inequalities is absent. They second the growing support for studies that are informed by theoretical and philosophical perspectives that make these issues visible. Additionally, there is a distinct lack of research in workplace learning specifically about engineering and issues related to diversity. This review highlighted the lack of research focused on workplace learning with

attention to positionality and structural inequality. Even though all of the literature focused on some aspect of positionality, only a few of the studies explicated a theoretical perspective (Howell, Carter & Schied, 2002; Mojab & Gorman, 2003; Palmer & Johnson-Bailey, 2005). In explicating a poststructural feminist and organizational diversity theoretical framework, the current mixed methods study that examines diversity in engineering can contribute to the workplace learning knowledge base and help bridge the gap between the primarily qualitative adult education and quantitative human resource perspective. The next section will examine the literature more specifically on underrepresentation in STEM. While many of the barriers are familiar, there is a distinct lack of research about learning within STEM organizations.

Underrepresentation in STEM

This study of course, is more specifically about engineers' experience and learning about diversity and gender in the engineering workplace. Thus a review of the specific literature related to STEM disciplines is in order here. The review of the literature will discuss the major themes including an overview of the various theoretical underpinnings or frameworks that inform the research studies.

As discussed in Chapter One, most of the literature relevant to underrepresentation in engineering has a context of STEM with a focus on gender inequality. Although reflective literature about gender inequality in STEM is fairly abundant, research based studies are less common. This literature review focuses on 26 research based studies from a range of disciplines and methodology to get a general overview of the issue as it is being reported in the literature. Major themes in the literature focus on barriers that prevent or discourage inclusion in STEM. These are; lack of mentors and role models, discrimination, the need to assimilate and an unequal

work and family balance. While these themes are not mutually exclusive, it is possible to highlight factors that are highly relevant for each on an individual basis.

Additionally, an emerging discussion about the use of conceptual frameworks appears in the women in STEM rhetoric. For example, instead of presenting a study with a framework of "The problem of women in STEM" recent research questions the former tactic and approaches the issue with a starting point of "The problem of STEM in regards to women." Of course the former view presents an underlying assumption that there is something "wrong" with women that needs to be fixed or that women need to change to be successful in STEM careers while the later puts the focus on the social/organizational structures, the traditional masculine model and exclusive practices. This change addresses research that indicates women do not enter STEM because of a *perception* (self concept) that *they* lack science and math skills (despite academic statistics that indicate they are on par or above their male counterparts) and that *they* won't be able to (or want to) balance the work demands of a traditionally male occupation and family responsibilities (Frome, Alfred, Eccles, & Barber, 2006; Gill, Mills, Franzway, & Sharp, 2008). Following the analysis of the major themes (lack of mentors and role models, discrimination, the need to assimilate and unequal work and family balance), a discussion of the implications of the theoretical perspectives of the research will be provided.

Mentors and Role Models

A common theme is the importance of having mentors and role models in STEM occupations. Mentors were described as people, within or outside of the work environment, who provided encouragement and information about how to succeed. Similarly, role models were described as people working in STEM environments that provided positive examples for a newcomer to emulate. Hult, Callister, and Sullivan's (2005) quantitative study of academic

women in SET revealed women's lack of participation (because they were not included/invited) in informal activities and therefore missed valuable networking and mentoring opportunities. The loss of these informal connections can lead to feelings of isolation and reduced development opportunities. Conversely, having mentors or role models can positively affect an individual's identity and affirm the choice of engineering as a profession (Gill, et al., 2008). Women with role models who encourage their aptitude in science and math may have a better self-image and a better appreciation of their strengths. Smith's (2000) qualitative research on women entering technology careers examined women who were successful in IT and found that same sex role models and mentors enhanced their educational and work experience, resulting in more positive outcomes. In another qualitative study of successful women in the IT profession, male role models, particularly family members, provided positive influences that affected women's decision to enter the field (Turner, Bernt, & Pecora, 2002). The women indicated that male figures in their lives provided encouragement of their skills which positively affected their self image and perceptions of career success. A mixed methods longitudinal study of career development from adolescence through young adulthood confirmed the importance of familial influence on career development (Messersmith, Garrett, & Davis-Kean, Malanchuk & Eccles, 2008). The participants who entered IT indicated they had parents who worked or played on computers and encouraged their interest. From a different perspective, Stephan and Levine's (2005) quantitative study on retention in the IT field reported a disproportionate attrition of women and recommends mentoring, as well as other changes such as providing child care, flexible work schedules and continuing education as strategies to reduce women's departure from the field. However, the data indicated demographic changes such as marriage and children

had no effect on retention. Additionally, the authors concluded that successful retention strategies remain elusive.

In a qualitative study of math professionals, Coyle (2001) identified a theme of family members acting as role models and mentors, encouraging women resulting in an increase of self efficacy and greater resiliency (to obstacles) in their career. This concept of family role models was echoed in a qualitative study of academic female engineers, "father was an industrial engineer in the Air Force and in junior high he said or they said I should be an industrial engineer…and my brother is also in engineering, electrical" (Benson, 1998). However, some of these same women indicated that despite the encouragement early on, the lack of mentors in the academic work environment limited their professional development.

Mentoring is seen as especially important to academic women in science due to competition for grants, research facilities and publishing requirements. In a qualitative study examining both men and women in academic science, women cited lack of mentoring as a reason for not competing for grants and not publishing, both of which leads to an inability to advance professionally in academia (Monhardt, Tillotson, & Veronesi, 1999). In a mixed methods study that drew from a large population of women employed in SET occupations, lack of female role models was cited as a major factor for women not entering the profession (Phipps, 2007). Kowtha's (2008) quantitative organizational socialization analysis on the effectiveness of socialization tactics as a tool for retention in new engineer adjustments finds that females respond better to investiture and serial tactics. He identifies these as social and collective tactics that support common learning experiences such as newcomer orientation cohorts where members bond through the experience. Informal role models help newcomers feel a sense of investiture or being a part of the organization. In light of the previous discussion on the elusive outcomes of

informal learning at work, this is an interesting line of research to investigate. In general, the discussions of mentors and role models lack critical analysis of how those relationships work to improve the climate and professional advancement for women. For example what can women learn from mentors and role models to facilitate their careers and is there a difference between formal and informal mentoring relationships?

Discrimination

A common theme addresses discrimination against women. For the purposes of this discussion, discrimination is defined as the unfair treatment of people or groups based on racial, gender or other identifying quality. Perhaps not typical, but certainly a transparent example of the gender bias in hiring is discussed in Tapia's (2006) qualitative study of dot-com era companies. Employees were hired initially because they were friends of the owner. As the need for more employees grew, hiring practices expanded to include friends of friends and eventually to "recruitment" parties at universities. The result was a workforce demographic that was 93% white, 82% male and most (over 80%) were single with no children. Tapia posits the hiring practices acted as a cultural sifter that is probably a part of any interview process but usually not at this level. The few female employees experienced an extremely competitive and gendered environment where, among other things, employees challenged each other to stay at the office longer and longer. While this is an extreme example, it may be significant in understanding and addressing the increasing lack of women in the IT profession.

Once hired, women in male dominated work consistently battle the assumption that they are not *good enough* and have to constantly *prove* themselves and *work harder* while their male counterparts are accepted as being competent without judgment or proof. Michie and Nelson's (2006) quantitative study of women in the IT profession focused on self efficacy as a moderator

to career success and an indicator of gender bias. Their findings concluded that males exhibited more self efficacy and viewed women as less capable in IT. Interestingly, while the women in this study indicated lower self efficacy and confidence personally, they attributed high levels of confidence to other women's abilities in IT.

In some instances women may have to prove their identity as a female member of the STEM profession. One participant in a qualitative study of academic female engineers related an experience where a male faculty member automatically assumed she was her research partner's secretary (Benson, 1998). This lack of automatic recognition of competence is reinforced by unequal pay, less challenging work responsibilities, lack of promotions and the pressure to assimilate to minimize difference and gain acceptance (Trauth & Howcraft, 2006). Two mixed method studies examined the experiences of academic physicist (Ivie, Czujko, & Stowe, 2002, Ivie & Guo, 2006). Despite reporting positive educational experiences, one third of academic female physicist had less career progress than their male counterparts and indicated less funding and lack of equipment was a factor. A quantitative study of female tenure track natural science faculty concluded that sexual harassment and gender discrimination was common in academic science and that those experiences affected job satisfaction negatively (Settles, Cortina, Mallery, & Stewart, 2006). In addition, in as much as job satisfaction is related to attrition, it is reasonable to say that sexual harassment and discrimination in academic science is responsible for women leaving those positions. These women indicated good leadership in the form of a department head who voiced zero tolerance for female marginalization was effective in creating non-hostile work environments.

Assimilation

Assimilation is a process whereby the other assumes the qualities and characteristics of the dominant culture (Banks, 2002). Assimilation is also seen as a method of coping with or putting up with masculine behavior such as speech that marginalizes women or display of objects like risqué posters. In a qualitative study of female engineers, women spoke of *fitting in* and minimizing their femininity. One study respondent said, "I just operated as an engineer and I never resorted to being a woman" (Gill, et al., 2008, p. 229). As described above, women are subjected to discriminatory practices in traditionally male environments no matter how hard they try to assimilate, but many women express that to vocalize an objection to this masculine behavior would be an overt reminder of the difference and may lead to further discrimination and alienation. In theorizing about their conclusions, Tapia (2006) and Trauth (2002) explain the conditions that resulted in STEM organizations not meeting women's needs. They reason that because the occupation was created by men, the organizational structures reflect a male dominant paradigm, especially long hours and unlimited availability to work. These work culture norms do not meet women's needs, especially when they are still responsible for most of the familial responsibilities including elder care. The dominant narrative of the workplace as gender, race and class neutral is simply not reflected in the research.

Work and Family Balance

The final major theme is the work and family balance, sometimes called work-family conflict. Work-family balance refers to the amount of time, effort and energy one expends in their professional role versus their private or family role. Work and family roles are unbalanced or incompatible when meeting the demands of one make it difficult or impossible to meet the demands in the other (Edwards & Rothbard, 2000). Despite occupying a near 50% (Boushey &

O'Leary, 2009; Bureau of Labor Statistics, 2008a) share of the workforce, society still views homemaking, caretaking and childrearing as primary female roles. This can cause considerable cognitive dissidence for women, particularly those in occupations based on dominant masculine ideology where long work hours and unlimited availability is the norm. For example, a quantitative longitudinal study tracked the career aspirations of 12th grade students through age 25 (Frome, et al., 2006). They found that 82% of the female high school graduates changed their male dominated career aspirations by age 25, citing a desire for a family flexible job as one of the reasons. While 21.4% of women refer to family issues as a reason for leaving STEM careers, only 4.5% of men do so (Litzler, et al., 2005). Quesenberry, Trauth, & Morgan's (2006) qualitative study examined work-family issues in IT, particularly the *mommy track*. Women are discriminated in terms of professional development and career choices regardless, but when they start a family comments such as "go home and be with your kids" (Quesenberry, et al., p. 45) are common. Women who opt out for a time to be full-time mothers or work part time to reduce their family-work demands seldom recoup financially or professionally.

Although the discourse that positions women as lacking the ability to handle demanding work environments and family responsibilities is frowned upon in some of the current literature of women in STEM, there is a social basis for women's reluctance to take on the challenge, regardless of whether social structure or socially constructed gender roles are responsible (Kimmel, 2008). A quantitative survey of SET faculty at Utah State University indicated women were more likely than men to have difficulty in balancing work and family life (Hult, et al. 2005). Academic female scientists and physicists echo their colleagues in experiencing difficulties balancing their careers and family responsibilities (Ivie, et al., 2002; Ivie & Guo, 2006; Monhardt, et al., 1999). The compromise often results in another theme, discrimination;

"It doesn't matter how productive I am. The fact that I made the choice to not be full-time means my career is not as important to me…even though I produced just as many publications in those three years as I had the time when I worked full-time" (Monhardt, et al., p. 539).

Although work-family issues are present in all STEM careers they can be especially damaging in IT where workers are often expected to work when needed, as long as *it takes* to meet deadlines. While interviewing IT professionals about the work-family balance, Quesenberry et al. (2006) examined the masculine organizational and domestic model that is the dominant paradigm. She posits that a new model would benefit men as well as women "as the traditional [IT] career is one that no longer reflects the needs and concerns of workers" (p. 50). Interestingly, Panteli, et al.(1999) reject the identification of IT as steeped in dominant male culture and argues that because it is a fairly young discipline, IT should be "capable of utilising freshly constituted forms of work organisation as the computing industry develops its own identity…" (p. 52). However, the mixed methods study confirmed the presence of the same barriers that other studies identified such as lack of opportunity and promotion, uninspiring work assignments, and lack of flexible work arrangements. Although he posits that the industry has an ethical responsibility to change structures that promote inequality, no course of action is suggested.

Although these findings are somewhat discouraging, women do succeed in STEM work environments and many feel quite good about themselves and their jobs (Trauth, 2002). A survey study of women and men in the IT field indicated there was no significant gender difference in terms of socialization, experience and attitudes. The only significant difference reported was that women felt more supported by their supervisor in terms of career goals (McKinney, Wilson, Brooks, O'Leary & Hardgrave, 2008). Trauth and Howcraft (2006)

consider women as active agents in their own destiny with the capacity to modify the masculine paradigm and highlight self efficacy as a source of perseverance. In addition, Trauth et al. (2008) present an important consideration of context in this complex issue. They examined environmental and economic influences in different parts of the country and concluded that there are geographic regions where women relate much more positive experiences about their IT careers. This is an under-researched topic and would benefit from further consideration.

In a similar vein, a quantitative study of interdisciplinary academic research environments indicated that women are more likely to participate in interdisciplinary research and that they translate these experiences to greater job satisfaction (Rhoten & Pfirman, 2006). This finding is quite encouraging as many federal funding sources are pushing an interdisciplinary agenda and it may be evidence of the male organization STEM paradigm being transformed. In that theoretical frameworks guide the line of inquiry in research, an examination of the theoretical trend of the literature may be valuable in understanding the strengths and weaknesses of the current research base.

Theoretical Frameworks used in the Empirical Studies

A theoretical framework provides the researcher with a structure or road map of what questions are being asked and how the data will be interpreted. It also provides the reader with an understanding of what the researcher was focusing on and how the framework guided the research. Less than 50% of the research studies explicated a theoretical framework. Of those that do, much of the literature is positioned in a general social constructivist framework examining women's construction of gender (Coyle, 2001; Messersmith, et al., 2008; Miche & Nelson, 2006; Smith, 2000). Social construction theory views gender as created in response to societal and structural influences. A number of the studies were also informed by Bandura's

Social Cognitive Theory with self efficacy being viewed as a principle factor for women succeeding in male dominated environments (Coyle, 2001; Litzler, et al., 2005; Michie & Nelson). Although none of the studies reviewed used an essentialist paradigm, Trauth (2002) explicitly discusses two traditional theoretical viewpoints, essentialism and social construction. Trauth also includes cultural influences as highly significant and criticizes social constructionists' tendency to assume all women are the same. Her research in IT focuses on the similarities between men and women as individuals. To accommodate that poststructural positionality perspective, Trauth created a theoretical framework, Individual Differences Theory and IT, based on social constructivism while recognizing that women's social and cultural experiences are different and that context is important. Gill et al. (2008) discuss a similar struggle between choosing a binary approach that positions women as lacking or the masculine structures of engineering as the deficit. The result is a vague theoretical stance (professional/personal identity construction) used to analyze the workplace for daily experiences and practices of men and women that gender the environment.

Settles, et al. (2006) offered a structural deficit theory that examines deficits in the structures in academic science that result in female discrimination. She concludes that traditional patriarchal hierarchy in academic science results in fewer women receiving tenure and promotion. Additionally, a negative or deficit environment (one that doesn't meet women's needs) results in lower job satisfaction that eventually leads to women leaving academia. Cognitive analysis informed by gender schema theory likened women's experiences in academic SET to chipping away or a wearing down that resulted in extreme unhappiness and eventual opting out (Hult, et al., 2005).

Only two of the 26 studies reviewed used an explicitly critical framework (Phipps, 2007; Tsai, 2003). Poststructural feminist theories of identity and discourse informed a study of women in physics (Tsai). The use of this framework resulted in a greater understanding of women's different experience. Three women physicist in an Asian country had very different experiences (and perceptions) within a male dominated environment. While one of the women embraced feminism and actively sought to change her environment, another refused to mentor female faculty or students and tried to distance herself from any perception of difference. Phipps (2007) rejected binary frameworks and grounded her study on Foucault's concept of discourse and power. She suggests that by laboring under a feminine deficit model, women researchers and support groups have contributed to the lack of women in STEM by contributing to the socially constructed perceptions of female inadequacies in math and science skills and incompatibility with family responsibilities.

Past research on the underrepresentation of women in traditionally male dominated environments focused on a "women as deficient" (Bystydienski & Bird, 2006, p. 4) model. Naming women as lacking in math and science skills, self confidence, and a competitive nature among other things, implied that women needed to change to fit into masculine environments (Phipps, 2007). This approach not only fails to examine complex relationships between social construction, structure and oppression but subtly reinforces binary and hierarchical perceptions.

Additionally, some women who self identify as being successful engineers do not identify with a feminist perspective and are reluctant to attribute unequal opportunity with gender (Jorgensen, 2002). However, gender is only a part of a person's positionality along with culture, race and socio-economic class as well as other areas of identity that define them (hooks, 2003). Framing underrepresentation in engineering as a women's problem ignores the exclusion

of other populations including men of color and white men who do not fit into the traditional definition of engineer. In general, the research examining underrepresentation in STEM fails to explicate a theoretical lens and when it does that lens lacks critical perspective and focuses on barriers without examining complex intersections and interactions within the workplace. Additionally, research that discusses the influence of learning and epistemology surrounding the issue of diversity in engineering workplaces is severely lacking.

Summary and Conclusions

This chapter reviewed the relevant literature relating to a proposed mixed methods research study concerning diversity in engineering. In particular, literature that provided an understanding of critical feminist perspectives informed by poststructural feminist theory and demonstrated its appropriate use as a framework for this study was reviewed. Few studies have examined diversity issues and/or diversity in engineering through a critical framework that pays attention to positionality, social structures, discourse and power. Examining engineering environments through such a lens may provide a greater understanding of how diversity is supported or thwarted. Additionally, the literature on multicultural theory and organizational diversity was reviewed to situate the current study in a critical multicultural paradigm. To be sure, applying poststructural concepts to a concrete diversity model is challenging. Theoretically, poststructural feminism disputes the validity of socially constructed categories and views individual identity and meaning making as fluid and shifting. Despite the theoretical conflict, there is value in attempting to analyze individual's understanding of how they interact with social structures, how power circulates and how discourse serves to deny or reinforce natural assumptions.

A review of the workplace literature revealed workplace learning as traditionally under the purview of human resource development, a field that historically has operated through a positivist paradigm viewing knowledge as objective and the primary function of workplace learning as a means of improving productivity. In contrast, adult education tends to view workplace learning through a critical lens placing value on the subjective nature of knowledge and workplace learning as complex where the workplace is a site that can serve to reinforce dominant ideology and oppression of non-majority members. This discussion is significant because engineering is very much aligned with the human resource perspective and as such little critical examination of workplace learning has occurred. Finally, research based literature on underrepresentation in STEM was reviewed. Much of the literature lacked theoretical grounding and very few studies examined the issue through a critical lens. As a consequence, the literature focuses on obstacles to inclusion but fails to address the complexity of the dynamics related to race and ethnicity in the workplace around structural inequalities.

CHAPTER 3: METHODOLOGY

The purpose of the mixed method study is to investigate engineers' perceptions of diversity and the workplace learning environment surrounding diversity education efforts in engineering occupations. In the analysis, particular attention was paid to the intersection of gender, race, and age. As stated in Chapter One, few studies have examined engineering climate using a theoretical lens that specifically attends to issues of discourse, power and positionality and there is a definite lack of research focused on diversity and workplace learning in engineering. A review of the literature failed to identify a survey instrument that contained reliability and validity data and addressed the concepts important to the current study. Therefore, the researcher modified an organizational diversity instrument, drawing questions from a number of studies as well as developing questions to include in the survey. The current study uses a workplace diversity climate survey that through a series of questions quantifies factors that have been found to be pertinent in culture climate assessments; (1) recruitment, (2) retention, (3) communication, (4) leadership, and (5) interpersonal climate (Ioannou, 2008; Murphy, 2005; Rasmussen, 2007). Two other factors, learning environment and employee engagement (job satisfaction) were added to specifically address the research questions that investigate the learning environment and to explore connections between workplace climate factors and employee engagement. A detailed discussion of the survey development process and the qualitative interview plan will be presented later in this chapter.

The research questions that guide this study are:(1) To what extent do engineers perceive that engineering worksites foster learning especially about diversity issues related to gender, race/ethnicity and culture? (2) What are engineers' perceptions of diversity in engineering

workplace culture? and (3) Do interactions between gender, race and age influence engineers' perceptions of diversity in engineering organizational culture?

In particular, 16 hypotheses were examined:

H1 Males are more likely than females to hold positive perceptions of recruitment.

H2 Older engineers are more likely than younger engineers to hold positive perceptions of recruitment.

H3 Males are more likely than females to hold positive perceptions of retention.

H4 Older engineers are more likely than younger engineers to hold positive perceptions of retention.

H5 Males are more likely than females to hold positive perceptions of communication.

H6 Older engineers are more likely than younger engineers to hold positive perceptions of communication.

H7 Males are more likely than females to hold positive perceptions of leadership.

H8 Older engineers are more likely than younger engineers to hold positive perceptions of leadership.

H9 Males are more likely than females to hold positive perceptions of interpersonal climate.

H10 Older engineers are more likely than younger engineers to hold positive perceptions of interpersonal climate.

H11 Males are more likely than females to hold positive perceptions of the learning environment.

H12 Older engineers are more likely than younger engineers to hold positive perceptions of the learning environment.

H13 Males are more likely than females to hold positive perceptions of employee engagement.

H14 Older engineers are more likely than younger engineers to hold positive perceptions of employee engagement.

H15 Across the six dependent variables associated with this project (recruitment, retention, communication, leadership, interpersonal climate, and learning environment) gender will play a greater role at predicting respondents perceptions than will race or age.

H16 Controlling for gender and age, perceptions of retention will better predict perceptions of employee engagement than will perceptions of recruitment, communication, leadership, interpersonal climate and learning environment.

While it was the intent of this study to examine differences in perception due to race, the sample lacked a sufficient number of people of color. Although disappointing, the fact that out of a sample size of 519, only 33 self-identified as a person of color confirms the disproportionate number of white people who participate in the engineering profession. The qualitative portion of this study did include interviews from two women engineers of color and their perceptions are documented in Chapter Five.

This chapter begins with a rationale for the use of mixed methods including an overview of the theoretical underpinnings of quantitative and qualitative paradigms. The background of the researcher, the participants, their selection process and a discussion of the data collection and analysis methods follows. Finally, the chapter concludes with approaches taken to ensure verification and trustworthiness.

Research Design

This study uses a research paradigm that combines both quantitative and qualitative analysis that is commonly referred to as a mixed methods research paradigm. The design falls in the sequential transformative type of mixed methods. In a sequential transformative design a specific advocacy framework is used, either type of data may be collected and analyzed first, priority may be unequal or equal, and data analysis is connected and integrated at the end (Creswell & Plano Clark, 2007; Teddlie & Tashakkori, 2009).

Rationale for a Mixed Methods Research Approach

The important reason in choosing a research method is that it is the right tool to answer to the research question(s) (Johnson, & Onwuegbuzie, 2004; Lodico, Spaulding & Voegtle, 2006). Mixed methods is a combination of quantitative research whose theoretical underpinning is more typically based on positivist philosophy and scientific methods and qualitative research that is based on an interpretive or naturalistic philosophy (Denzin & Lincoln, 2000).

Quantitative inquiry has a positivist foundational belief that objectivity (value free inquiry) can be achieved and *truth* can be obtained through the use of scientific methods (Teddlie & Tashakokori, 2009). However, in the postpositivist era, most people recognize that given human nature and equipment limitations, any scientific experiment has design flaws and that values are embedded; therefore researchers can only limit factors that compromise validity, reliability and neutrality (Lather, 1991). The research study makes use of a quantitative workplace climate survey research instrument.

A research paradigm that uses a quantitative data collection method is appropriate for this study because the larger sample size and quantitative data collected from the survey allows for an overall understanding of engineers' perceptions of their workplace diversity climate. In that

few studies have examined engineering workplace diversity climate, this baseline information could provide a foundational understanding of engineering culture and a starting point for additional research. Survey results were also analyzed to investigate the relationships between the positionalities of gender, race and age and the workplace diversity climate. This information adds to the knowledge base of positionality intersection and may provide information that will assist engineering occupations in creating more inclusive environments. Additionally, the field of engineering is a discipline that views knowledge primarily through a positivist, objective paradigm. For this study to be valued and inform the field of engineering, a quantitative research method that has a theoretical base of objective knowledge is desirable; further, collecting data from a large sample of engineers is helpful in understanding how they view workplace culture and for ascertaining differences based on positionality of race, gender, and age. Critical feminist perspectives more often use qualitative inquiry to understand the particular, in-depth, and how individual participants make meaning in light of their experience and positionality (Lather, 1991, 1992). Current thought endorses mixed methods research as a means to contribute to methodological pluralism in feminist inquiry (Hodgkin, 2008). Data analysis from the quantitative survey will inform the qualitative portion and identify a sample population for the interviews. The survey is designed to collect basic demographic information about the engineers and examine their perceptions of workplace culture climate. The sample population for the qualitative interviews will be selected from this information and will consider women, women of color, and women less than 40 years of age who indicate a willingness to participate in the interview phase. In particular, to ascertain *why* engineering lacks inclusion of women and people of color, the experiences of those who view engineering workplace culture as not fostering a climate for diversity will be highly considered.

While quantitative inquiry that makes use of a survey methodology can provide an overall understanding of the issue through data collected impartially and at a distance, qualitative inquiry provides an opportunity to deepen that understanding through direct contact with participants who relate their subjective understanding of the issue (Cresswell & Plano Clark, 2007; Sosu, McWilliam & Gray, 2008). Ontologically speaking, quantitative research has a foundational belief in impartiality as a way of finding an objective reality while qualitative research has a foundation of believing in the constructed and multiple nature of a reality that is dependent on context (Guba & Lincoln, 2000). In this sense, the *objective reality* of the quantitative portion of the study is the reality of what engineers perceive about diversity and differences between groups in those perceptions; in the qualitative portion of the study, how a subgroup of participants ascertain and construct their reality will be made visible.

Qualitative inquiry uses an interpretative method of data analysis to make conclusions that represent the subjective reality of the participants under study (Denzin & Lincoln, 2000). Because the current study uses a critical theoretical lens, it is important to gather rich thick descriptive data that represents the perspectives and voices from engineers typically understood as marginalized (meaning not being accepted as members of the dominant group); mixed methods provides an opportunity for marginalized population to tell their story (O'Cathain, Murphy & Nicholl, 2007). A qualitative inquiry through in-depth semi-structured interviews allows for a deeper analysis of significant findings through personally articulated perceptions and experiences. As with expanding the research base in critical feminist research by using a quantitative paradigm, a qualitative paradigm can introduce methodological plurality in engineering, a discipline that relies on quantitative inquiry in search of an *objective truth*.

Demonstrating the value of qualitative data and broadening the definition of knowledge may enhance engineering's understanding of different perspectives.

Finally, for the current study, a mixed methods research paradigm offers an opportunity for more comprehensive findings about a little known topic. Analysis of both quantitative and qualitative data can increase validity in that data collected from one method provides a more nuanced understanding of data collected from the other. In short, the qualitative findings can provide an understanding of the *why* identified by the *what* from the quantitative results (Hodgkin, 2008). Currently, mixed methods research design is becoming increasingly popular as a way to provide methodology diversity and a more complete understanding of the subject of the study (Valdero, 2005). Using a research design that includes both qualitative and quantitative components assists a researcher by providing two types of data, with each contributing a unique value and perspective to guide the direction of the research. In addition, federal funding agencies and scholarly publication venues have different expectations in terms of quantitative and qualitative research. Mixed methods can serve those dual purposes. The next section provides an overview of the specific mixed methods research design for the current study.

Type of Mixed Methods Research Design

Cresswell (2003) discusses approaches for mixed methods that are organized based on the timing of data collection, integration or mixing of the data for the analysis and framework. Three fundamental categories provide the basis of the approaches; sequential, concurrent and transformational (use of a specific advocacy framework such as a critical or feminist perspective). Concurrent approaches collect quantitative and qualitative data at the same time, sequential approaches collect either qualitative data first followed by quantitative data or vice a versa and transformational simply specifies the use of an advocacy framework. As previously

discussed, the design for the current research collects quantitative data first to provide a general understanding of the issue and inform the qualitative inquiry through sample selection and interview content. As such, it uses a sequential design. An explanation of sequential designs follows.

Sequential design strategies are: explanatory, exploratory and transformative. *Sequential explanatory designs*: (a) do not use an advocacy framework, (b) quantitative data are collected and analyzed followed by qualitative data collection, (c) priority is uneven and usually given to quantitative, and (d) data analysis is connected and integrated at the end. *Sequential exploratory designs*: (a) do not use an advocacy framework, (b) qualitative data is collected first and analyzed followed by quantitative data, (c) priority is uneven and given to the qualitative data, and (d) data analysis is connected and integrated at the end. *Sequential transformative*: (a) use a specific advocacy lens, (b) either type of data may be collected and analyzed first, (c) priority may be unequal or equal, and (d) data analysis is connected and integrated at the end.

Since the design for the current research uses an advocacy (critical diversity model and critical feminist perspective informed by poststructural feminist theory) lens, it falls in the sequential transformative design (Cresswell, 2003). The critical feminist lens is referred to as an advocacy framework in the sense that the findings can provide a basis to advocate for women and minorities. The study will collect and analyze the quantitative piece first so that the findings can serve to inform the qualitative design. Data analysis will be equal (the quantitative and qualitative results will be given the same consideration) and integrated at the end. Placing the same attention on the quantitative as the qualitative data analysis is important in a study that places as much emphasis on the importance of the engineering aspect as it does on the understanding of individual perceptions of imbalanced work environments. Before I explore the

specifics of the quantitative and qualitative inquiry, as a feminist researcher who is also connected to engineering and a scientific paradigm, it is important for me to position myself within this research and disclose how I situate myself within the topic.

Background of the Researcher

As a woman with undergraduate degrees in chemistry and engineering who does not currently practice as a scientist or engineer, I am concerned about the unequal social and structural environment in engineering. From my undergraduate education through my work as a laboratory supervisor in an academic environmental engineering department, I was frequently the only woman and engaged in a variety of tactics to survive. Those survival mechanisms included compartmentalizing my professional and personal life and assimilating a masculine model in my career. Additionally, I routinely ignored gendered and sexist comments, was the target of discrimination and was not paid in parity with my male counterparts - in spite of having an undergraduate degree in environmental engineering technology in comparison to my counterparts' lesser academic qualifications. Although I was not always cognitively aware that I was living a double life and that my behavior was not authentic, eventually it became a personal struggle and I engaged in self reflection that led me to opt out of career in a traditional male dominated field.

My personal experiences of being educated and working in white male dominated environments prompted my investigation of a dominant culture that excludes capable and talented people to the point of its own detriment. I am familiar with some aspects of the culture and structures that are oppressive such as unequal pay, my abilities being perceived as less than my male counterparts and the need to assimilate. Additionally, I continue to work with the engineering community in an educative capacity. Because of my undergraduate engineering

degree and my ability to portray an engineering persona (speak the language), I maintain some credibility with an engineering audience. I have a unique perspective of being on the inside, a woman who was educated and worked in a male dominated culture as well as on the outside looking in, as an observer of the engineering community through a critical perspective.

Because of my background in science and engineering, I have a strong understanding of and experience in quantitative inquiry. However, my experiences in adult education have enhanced the value I place on qualitative analysis, the plurality of experience and critical analysis. Considering my experience in two very different theoretical environments it is no surprise that I consider myself a pragmatic and see the value in both scientific models of inquiry and a constructivist/interpretivist paradigm. Therefore, mixed methods also appeals to my praxis oriented philosophy of education, my lifelong self identification as a feminist and my theoretical and educational background as a scientist, engineer and adult educator. Placing equal emphasis on quantitative and qualitative data is in keeping with a pragmatic philosophy and addresses the needs of an engineering audience and research based on critical foundations. The different underlying theoretical paradigms for quantitative and qualitative research require different considerations in sample selection. The next section will review the sample selection and sampling techniques beginning with the quantitative survey followed by the qualitative interviews.

Sample Selection

The current study makes use of a survey research methodology, and includes survey participants from which a subgroup of participants will be chosen for qualitative in-depth interviews. The interview questions build on the survey results and include open ended questions based on the survey as well as questions focused on the workplace learning

environment and employee engagement. A discussion of the qualitative sample selection and interview questions follows the survey discussion. The survey research focuses on a workplace climate survey designed to measure workplace culture's support of diversity. It is designed to measure seven components of culture that affect diversity: recruitment, retention, communication, leadership, interpersonal culture, the learning environment and employee engagement. The survey instrument will be discussed in further detail after the next section that examines the selection of the survey sample.

Quantitative Survey Sample

The population of a research study refers to the "larger group about which a researcher wants to make statements" (Lodico, Spaulding & Voegtle, 2006, p. 140). These "ideal" (p. 142) populations are often large and impractical for research studies (Lodico et al.). Frequently, a smaller "realistic" (p. 142) population is selected for the purposes of the study (Lodico et al.). Finally, the sample is defined as the subset of the larger population under study (Dillman, 2007; Lodico et al.). While the ideal population for the proposed study is engineers in the United States, the realistic population is engineers who are licensed in Pennsylvania to practice as professional engineers. Because the proposed research is a mixed methods study, it is important to understand that quantitative and qualitative methods differ in their sampling philosophies, data collection and analysis. The sampling procedures employed in this study are explored in the following sections. The sample and sampling procedure for the quantitative survey instrument will be discussed first.

Quantitative analysis is concerned with the ability to generalize findings from the sample studied to the larger population. To maximize the chance that a representative sample from the entire population is obtained, probability sampling techniques are used (Dillman, 2007). The

population for this study is engineers who are deemed qualified to practice as professional engineers (PEs) by Pennsylvania and the National Council of Examiners for Engineering and Surveyors. The Pennsylvania list of PEs contains approximately 40,000 records and provides engineers' names and addresses. The sample for the quantitative survey will be selected from this group.

The size of the sample depends on the population size, how much sampling error can be tolerated, population variation with respect to the characteristics being measured and the amount of confidence that the estimates obtained for the sample pertain to the entire population (typically set at 95 percent) (Dillman, 2007). According to this criteria, if the population of professionally accredited engineers in Pennsylvania is approximately 40,000 (Np), a sampling error of plus or minus 5 percent is deemed acceptable and to be on the conservative side, a large population variance is assumed, the sample required is 381 (Ns) (Dillman, p. 207). However, this sample size is adequate only for making conclusions about the entire population. In the case of the hypotheses that focus on gender, race and age or intersections of these dimensions, one would have to examine the subsample size in the population. For example, women's participation in engineering is estimated at 15 percent (Bureau of Labor Statistics, 2008b). Using the same criteria that were used to select the sample, if the number of women represented in the professional engineering list is 6,000, then 361 women would need to be represented in the sample (Dillman). Given that the list does not specify gender, race or age, and assuming the same issue of smaller representation in the population exists for people of color and perhaps even age categories, sampling strategies that provide a maximum representation for the hypotheses associated with race and age, may be difficult to achieve. The next section will discuss the sample selection strategy and the implications for the study.

Random sampling implies that all persons in the population have an equal chance of being selected for the sample. Although random sampling is the most desirable sampling technique to prevent sampling error and for generalizability of the results (Krathwohl & Smith, 2005; Lodico et al., 2006), as discussed previously, it is likely a random sample of 381 records from the entire list will not provide a sufficient sample size of women, people of color or perhaps even those in different age categories. Unfortunately, the sample list does not contain information about race, ethnicity or age. However, to ensure an adequate sample size of women, a stratified sampling technique was used.

In order to ensure a sufficient sample of women, a stratified sampling technique using a database to analyze common patterns involving the first name determined whether the name is more commonly for a male or a female (Peters, n.d.). This resulted in a sample of 1,768 women and a sample of 30,929 men. Using a 3-contact Tailored Method with a specialized sample population "whose education is not particularly low" (Dillman, 2007, p. 5), an estimated 50% response rate was used. This resulted in a randomly selected sample of 644 for the female list and 762 from the male list (B. Sims, email communication July 21, 2010) for a total of 1,406 mailed surveys. Following Dillman's (2007) Tailored Design Method, the mailing consisted of three contacts: (1) the survey with a detailed cover letter explaining what the survey is about, why participation is important and the date needed for return. A self-addressed stamped envelope was included for survey return, (2) a thank you follow-up postcard was sent two to three weeks after the survey mailing expressing thanks for completing and returning the survey and if it has not been completed it is hoped that it will be returned soon, and (3) a replacement survey was sent to non-respondents two to four weeks after the postcard was sent (Dillman, p. 151). With 527 completed surveys returned, the overall response rate was 37.5 percent. The

survey response for female list was 37 percent and for the male list 37.9 percent. As mentioned before, because of the lack of demographic data available from the list, there was no method to identify people of color or those of different age groups. Thus using a sample strategy that enhances participation of people of color and those of different age groups was impossible and the sampling method used resulted in a sample size for engineers of color of six percent. Additionally for the five age groupings (30 and under, 31-40, 41-50, 51-60 and 61 and above) the sample percentages were quite similar with the exception of the 30 and under group which was represented at two percent. Additional descriptive demographic information about the sample is presented in Chapter Four. Other sample limitations are discussed below.

Professional licensure requires four years practicing under a professional engineer and therefore, would exclude those practicing for less than four years. Additionally, engineers who work in the engineering profession, but did not obtain their professional engineering license would be excluded. Another consideration is the lack of inclusion of all engineering disciplines. Certain engineering disciplines value professional licensure more than others. For example, it is likely a higher percentage of civil engineers versus a smaller percentage of electrical engineers will be represented. The researcher considered other sample populations including members of professional engineering societies such as the *Society for Professional Engineers* and engineering alumni from the Pennsylvania State University, but again, these lists contain limitations. In the case of professional societies, the population is limited to participants who are current members of those organizations. The Penn State alumni list limits the population to engineers who graduated from Penn State. Additionally, it is safe to assume that any engineering population would contain the same issue of low representation of women and people representing ethnic minorities.

Qualitative Interview Sample

The purposeful sample for the qualitative interviews consisted of eight female engineers and was selected following an analysis of the quantitative data. According to qualitative sampling criteria, participants are chosen that will provide for "information-rich cases" (Patton, 2002, p. 230). Since this research is interested in understanding why engineering is predominantly populated by white males and traditional engineering culture has been discussed as a barrier to diversity, those who do not suffer from the *invisibility of white male privilege* (McIntosh, 1989) may be better able to articulate why the culture is, in the words the words of a well-known diversity expert "toxic" (Cox, 2001, p. 12). The qualitative sample was selected according to the following criteria: (1) indicate a willingness to participate in the interview, (2) self-identification as a female, (3) self-identification as a woman of color, (4) those who are aged 40 and under, and (5) those whose survey results generally indicate engineering workplace culture does not foster a climate for diversity and/or do not like their job. To select the sample, the survey data was analyzed according to the above criteria with an attempt to overlap the criteria where possible. Of the 13 women who indicated they were women of color, two consented to an interview. Both of these women were selected for an interview. Of the 83 women aged 40 and under, four also indicated they were dissatisfied with their job. All four had consented to and were selected for an interview. The final two interview participants were selected because they answered survey questions in such a way that indicated their organization did not support diversity, learning about diversity and/or a healthy family-work balance and agreed to be interviewed.

Data Collection

In mixed methods research, two types of data collection occur. In the current study, quantitative data will be collected and analyzed first. The results of this analysis will be used to inform the qualitative portion. The next section will discuss the procedures used in the quantitative instrument development and data collection followed by qualitative data collection.

Survey Development

Despite an increase in literature on workplace diversity and an agreement on the need for evaluation tools that go beyond counting the numbers of women and minorities in particular situations, research-based development of instruments that measure workplace diversity has not kept pace with the conceptual literature on workplace diversity (DeMeuse & Hostager, 2001, Turnbull, Greenwood, Tworoger & Golden, 2009). Additionally, it is highly recommended that workplace climate surveys be contextual (Cox, 2001; Rasmussen, 2007). To be sure, measurement of workplace climate or culture climate through a survey is becoming more common; however, most survey instruments are customized and internal to a specific company and/or performed by training or diversity consultants and/or are proprietary. Beyond identifying a need for diversity measurements and indicating that those measurements should be customized to the context, few surveys exist with reliability and validity data (DeMuse & Hostager; Ioannou, 2008; Vactor, 1999). Important considerations in survey research include validity and reliability of the instrument or questionnaire. Factor validity indicates that a question is measuring the construct intended. Reliability refers to the variance of responses on questions designed to measure the same construct (Krathwohl & Smith, 2005; Lodico et al., 2006; Salkind, 2004).

Because a literature search failed to produce an appropriate workplace climate survey that was validated and reliable, the proposed research will use a survey instrument that is based on

the diversity mosaic model workplace climate survey (Rasmussen, 2007). Although this instrument has not been validated or tested for reliability there are benefits for its use. First, it contains constructs deemed important in measuring an organization's commitment to valuing diversity according to the current research's theoretical framework. These constructs are recruiting, retention, communications, leadership and interpersonal climate. Second, the proposed research will perform scale reliability on the modified instrument and that may well enhance the understanding of measuring workplace climate for not only the diversity mosaic model but other programs targeted at praxis within organizations. Third, it allows for modification of the instrument to include workplace climate issues that have been identified as barriers to inclusion in the engineering workplace. For example, issues of inflexible work schedules, lack of professional development opportunities that lead to advancement, exclusion in the decision making process and feeling de-valued as an employee have been identified as factors that cause women to leave engineering (Gatta & McKay, 2003). The researcher drew from a number of sources to identify questions that were relevant to the diversity factors. Additionally, the researcher developed questions to include in the survey. A detailed explanation of the survey development process follows.

In assessing workplace culture, the diversity mosaic model uses, in part, a workplace climate survey, the diversity mosaic workplace culture survey. The diversity mosaic workplace culture survey focuses on factors of recruitment, retention, communications, leadership, and interpersonal climate to assess workplace climate for diversity. For the purposes of investigating the research question, "To what extent do engineers perceive that engineering worksites foster learning, especially about diversity issues related to gender, race/ethnicity and culture," a learning environment factor was added. To investigate the documented issue of women *opting*

out of employment in engineering fields and to add to the understanding of the relationship between workplace climate factors and job satisfaction, an employee engagement factor was added. The seven factors included in the engineering workplace climate survey are: (1) recruitment, (2) retention, (3) communication, (4) leadership, (5) interpersonal climate, (6) learning environment and (7) employee engagement. Conceptual definitions of each factor can be found in Table 1.

Table 1

Conceptual Definitions of Diversity Factors

Factor	Conceptual Definition
Recruitment	The organization's ability to recruit underrepresented employees.
Retention	The organization's ability to retain underrepresented employees.
Communication	The quality of communication within the organization that supports inclusion and articulates a shared mission and goals.
Leadership	A measure of how effective leadership is in promoting and valuing diversity.
Interpersonal Climate	An organization's ability to provide an environment where all employees feel valued and respected regardless of gender, race, age, etc.
Learning Environment	The organization's ability to encourage and foster a positive learning environment, particularly in regards to diversity issues.
Employee Engagement	A measure of how satisfied and committed an employee is to their position in the organization.

Development of a culture climate survey for the engineering workplace began with examining the questions from the diversity mosaic workplace culture survey for face validity. Face validity is a determination of whether or not a question appears, based on common sense or known definition, to be measuring the construct it was designed to measure. All original questions were converted to statements with appropriate responses to be indicated on a Likert scale that ranged from one through four (with one being strongly disagree, two disagree, three agree and four strongly agree). Upon examination, it was determined that some of the recruitment questions did not hold up to a face validity examination and were deleted. One statement, "It is important to learn the unwritten rules to get ahead" was moved to the learning factor as it was interpreted by the researcher as investigating the informal learning environment.

Additionally, relevant workplace climate surveys from the literature were reviewed to compare factors and statement coverage and wording (Davis, 1998; Ioannou, 2008; Murphy, 2005; Vactor, 1999).

Davis (1998) reported on a workplace climate survey she developed relating to nurse managers' perceptions of diversity. Twelve questions pertained to the factor workplace climate. Upon examination the questions/statements were similar to the ones used in the diversity mosaic workplace culture survey. Ioannou's (2008) diversity satisfaction scale included a factor analysis that identified three factors related to workplace climate, recruit and retain, climate for diversity, education for diversity. Three statements from the recruit and retain factor were added to the recruit factor and one from education for diversity was added to the learning environment factor. Murphy (2005) developed a survey examining the perceptions of effective workplace diversity in the non-profit sector. After factor analysis, she identified three significant factors related to workplace climate, organizational disposition to diversity, tolerance to interpersonal relations, and attention to diversity at the individual level. In total, 11 statements from Murphy's survey were incorporated in the engineering workplace climate survey. The engineering workplace climate survey content was then reviewed to determine if it addressed the research questions and concepts important in the proposed research.

The literature on women in non-traditional occupations identified lack of mentors and role models, lack of professional development opportunities that lead to advancement, discrimination, required assimilation, work and family balance (inflexible work schedules), exclusion in the decision making process and feeling de-valued as an employee as reasons women fail to enter or opt out of STEM (Gatta & McKay, 2003). The issues of assimilation and work/family balance were not explicitly addressed in the diversity mosaic workplace culture

survey or any of the reviewed survey literature. Therefore, the researcher developed statements related to these issues and included them under the interpersonal climate factor.

Although organizational climate that results in positive learning attitudes is not well defined, some characteristics include employee empowerment, flatter leadership structure (distributed leadership), values as expressed are consistent with values that are modeled, mentoring and peer support, shared vision, appropriate rewards, effective communication, feedback and trust and opportunity to fail in the process of growth (Gardiner, 1999). While some of these characteristics were already addressed in the diversity mosaic workplace culture survey and the survey literature (leadership, shared vision, appropriate rewards, communication and trust), learning specifically related to diversity, types of learning activities and the value the organization places on learning was absent. Questions were developed that reflected those issues. Finally, employee engagement questions were added (Murphy, 2005). Demographic information was included at the end of the survey. The last step was to review the engineering workplace climate survey for face validity, relevancy and redundancy. The data analysis includes descriptive statistics, scale reliability analysis to analyze the internal reliability of the survey, data reduction to collapse the individual questions into indices and statistical methods of correlation and regression to answer the hypotheses (DeCoster, 1998; Ioannou, 2009; Salkind, 2004). The statistical analysis will be discussed further in the data analysis section.

Survey Distribution

The engineering workplace climate survey was distributed through the mail to the sample selected from the Pennsylvania Professional Engineer's list using Dillman's (2007) Tailored Design Method. To enhance the response rate, the mailing consisted of three contacts: (1) the survey with a detailed cover letter explaining what the survey is about, why participation is

important and the date needed for return. A self-addressed stamped envelope was included for survey return, (2) a thank you follow-up postcard sent a week after the survey mailing expressing thanks for completing and returning the survey and if it has not been completed it is hoped that it will be returned soon, and (3) a replacement survey sent to non-respondents two - four weeks after the first survey was sent (Dillman, p. 151). Surveys were numbered and the completed surveys were coded into SPSS with the identification number to ensure participant privacy.

Qualitative Data

Qualitative research is not typically concerned with generalizing results to larger populations but is concerned with understanding participant's experiences and perceptions in their natural setting (Lodico et al., 2006; Patton, 2002). It seeks to examine subjective reality through participant's narratives and allows for in-depth analysis of constructs identified in survey instruments (Cresswell, 2003; Valdero, 2005). The qualitative piece consisted of in-depth interviews, where participants were selected based on their ability to provide insightful information about the subject under study (Lodico et al.; Patton). The researcher recorded her process, perceptions and anecdotes in a field notebook. In particular, the interviews sought to gain an understanding of women, women of color, and younger women's experiences working in engineering and their perceptions of the engineering workplace culture climate for diversity and learning about diversity. Additionally, questions that give insight and relate to positive attributes of a learning organization such as vision, empowerment, appropriate rewards, effective communication and trust (Gardiner, 1999) were included. For example, "Can you tell me about what your organization is doing to show value for diversity?" The effect of the organization's culture on informal learning was explored through an examination of the hidden curriculum;

"Can you tell me about an experience where 'unwritten rules' or 'business as usual' conflicted with your organization's official policy?"

Questions were open-ended, meaning participants respond in their own words and not from a list of preselected responses (Krathwohl & Smith, 2005; Lodico et al., 2006; Patton, 2002). The interviews made use of a semi-structured interview format where the researcher asks prepared questions, but also asks clarifying questions to explore themes in more depth. An interview guide contained the list of questions to ensure the same questions were being asked of each participant (Hoepfl, 1997). In order to integrate the quantitative data with the qualitative data, selected survey questions were made open-ended and included in the interview questions. For example, "I feel respected as a person in my job." was asked as "How does your organization show respect for its employees?" with a follow-up "Can you tell me about a time when you felt respected in your organization?" However, the use of a sequential transformative approach mixed methods approach allows for the quantitative data analysis to inform the qualitative component. For example the quantitative data analysis indicated a particular area of concern or a topic (engineering doesn't need to Pay attention to diversity because no prejudice exists) that warranted further investigation, and the interview guide was amended. The interview guide can be found in Appendix B.

Interview data was collected through transcriptions of recorded tapes of the interview. In qualitative data collection, the researcher is intimately involved in the data collection (Patton, 2002). As previously discussed, researcher bias is an important consideration in performing the interviews. The need to avoid leading or suggestive questions, remarks and body language will be important. Although my perceptions are an important piece of the study and recorded in field

notes and observations, I wanted the participants to relate their perceptions and experiences as honestly as possible and not tell me what they thought I wanted to hear.

Data Analysis

In quantitative research, the reliability and validity of the data collection instrument are key considerations. Validity is a measure of how well the instrument evaluates the constructs it was designed to assess and that the questions are not biased or subjective (Lodigo et. al., 2006). The engineering workplace climate survey instrument was created by modifying a workplace climate survey from the diversity mosaic model. These modifications included eliminating some original questions, adding researcher developed questions and questions from other workplace climate surveys (Ioannou, 2008; Murphy, 2005; Rasmussen, 2007). The data was initially analyzed for scale reliability using Cronbach's alpha a test. This statistical test is used to determine if the questions designated at measuring a particular construct are consistent with each other (Salkind, 2004).

Survey results were analyzed using SPSS statistical software to answer the hypotheses. Descriptive statistics were run to describe the data in terms of general and central tendencies and examine relationships (correlations) between the data (Salkind, 2004). For example, is there a relationship (correlation) between gender and engineers' perceptions of the factors related to workplace climate? Additionally, a multivariate statistical analysis was run to examine the extent that factors of workplace climate can predict employee engagement.

The data gathered from the interviews were transcribed and analyzed by constant comparison, a method of organizing data that begins with identifying commonalities, organizing categories and finally coding for themes and patterns (Patton, 2002). It is an inductive process, meaning that the categories or themes come from the data and are not preconceived by the

researcher. This method consists of four stages when examining the data: (1) comparing incidents applicable to each category, (2) integrating categories and their properties, (3) delimiting theory, and (4) writing theory (Glaser, 1965). In the first phase, the raw data is coded or categorized according to major themes. In the second phase categories are further examined to see if concepts are linked or similar. If categories are found to be similar, they are combined. In the third phase, the researcher continues to examine the data to determine if there is further reduction of categories or if any new categories are present. Saturation is achieved when all categories are discreet concepts and no new concepts emerge. Finally, the major themes are identified and the relevant data are organized and presented according to the themes.

After each interview, I transcribed the data, refered to my field notes and reflected on the content. Any insights gained from this activity were recorded in my notes. Following transcription, I performed a member check to ensure that my transcript and observations were consistent with the participant. Participants were provided with the transcripts to check that the content recorded corroborates with their intended meaning. After the member check, I began the coding process by carefully reading my transcribed data, and analyzing the data for meaningful concepts. I created a list of codes to help me analyze subsequent transcripts. I continued to add and revise the codes in the process and review previous transcripts for new concepts.

In keeping with the sequential transformative design previously described, analysis was equal and integrated at the end. One of the strengths of mixed methods research (plural research methods) is that data from the quantitative and qualitative sections can provide additional support or methodological triangulation, if the findings from both methods are consistent (Lodico et al., 2006; O'Cathain, Murphy & Nicholl, 2007).

Verification and Trustworthiness

Mixed methods research relies on standard strategies to verify the trustworthiness of data for the quantitative and qualitative methods as well as specific approaches that enhance the congruency between the methods. A validity procedure specific to mixed methods research is sometimes referred to as inference quality and increases the credibility of a mixed methods study (Creswell & Plano Clark, 2007; Teddlie & Tashakkori, 2009). The following paragraphs will describe the strategies employed in the quantitative and qualitative portions of the research as well as those strategies used to enhance inference quality.

Inference quality or validity specific to using a mixed methods design is enhanced by using a sub-sample of the survey participants for the semi-structured interviews and paying particular attention to data that is inconsistent between the two methods. Using the same questions in both quantitative and qualitative approaches also increases inference quality (Creswell & Plano Clark, 2007). According to the previously discussed criteria, the current research will use a sub-sample of the quantitative survey participants for the qualitative interviews and interview questions will be taken from the survey and modified to be open-ended. Although the quantitative instrument will be analyzed first and results used to inform the qualitative piece, data analysis will be equal, connected and integrated at the end increasing transferability and legitimacy between the two paradigms (Creswell & Plano Clark). In addition overall dependability is increased by using plural methodology particularly when the findings from the quantitative and qualitative portions are consistent (Patton, 2002).

In quantitative research, the ability to generalize the results is supported by probability sampling individuals that are representative of a larger population and having a sample size large enough to be statistically significant (Dillman, 2007; Creswell & Plano Clark, 2007; Salkind,

2004). As previously discussed, the sample size will be determined according to standard sampling procedure. A stratified sample technique was used to increase the participation of women. Three mail contacts will be made to enhance the response rate.

Several strategies will be employed to enhance the verification and trustworthiness of the qualitative piece. Verification is the process of confirming that what the researcher interprets from the data reflects what the participants intended. Approaches that identify and correct errors before they compromise the data and analysis are built into the research design and as such perform a formative evaluation role. Qualitative constructs that can demonstrate the trustworthiness of qualitative research are confirmability, credibility, dependability and transferability (Lincoln & Guba, 1985; Patton, 2002).

Confirmability or the ability of others to corroborate a study's results relate to researcher neutrality and disclosure. I identified my relationship with the research study to the participants and in the research study report. Additionally, a deliberate attempt was made to identify contradictory results. When contradictory results were present they were reported in the data analysis. Maintaining a notebook consisting of raw data, transcripts, field notes, process synthesis and conclusion notes was an important method of conserving data integrity. The maintaining of this record also provides an audit trail that contributes to confirmability by providing a means to review prior data and conclusions. A means of triangulation or multiple ways of confirming the consistency of the data is the ability to compare quantitative results with quantitative results, review of prior material and member checks (Hoepfl, 1997).

Member checks or transcript reviews of the qualitative interviews can also provide a method of increasing the credibility. Participants reviewed their interview transcripts to ensure the data reflects their intent. I also engaged in reflective practice concerning the data and

recorded those reflections in field notes. Triangulation and audit trails increase dependability as well, ensuring that the data collection methods and the research process is clear and readers of the research will be able to understand the progression from the data to the results. The field note reflections, transparency of the research methods and dense reporting of the data using participant quotes can also contribute to increased credibility (Merriam & Simpson, 2000).

Inclusion of thick description of the researcher's observations, methodology, sample, data collection and analysis can also increase the study's transferability; the degree to which the findings from one study can be applicable to other situations (Merriam & Simpson, 2000). The researcher's field notes and journal will be used as resources in this description. Although qualitative research is not typically meant to be generalized, it is possible to strengthen "reader or user generalizability" (Merriam & Simpson, p. 103).

Summary

The purpose of this chapter is to provide an overview of the methodology for the proposed research project. The chapter began with a rationale for the use of mixed methods. A discussion of the quantitative and qualitative phases of the research included identifying the sample population, probability sampling procedures for the quantitative survey and purposeful sampling criteria for the qualitative interviews. A discussion of the survey instrument included a rationale for the survey development and exploratory factor analysis to ensure the survey questions are reliable. Questions for the semi-structured interviews will come from the survey and modified to be open-ended. In addition, the data collection and analysis methods were presented. Finally, the chapter concluded with approaches taken to ensure verification and trustworthiness.

CHAPTER FOUR: QUANTITATIVE FINDINGS

The purpose of this research study was to investigate engineers' perceptions of diversity and the workplace learning environment surrounding diversity education efforts in engineering occupations. The research questions that guide this study are:

1. To what extent do engineers perceive that engineering worksites foster learning about diversity issues related to gender, race/ethnicity and culture?
2. What are engineers' perceptions of diversity in engineering workplace culture?
3. Do interactions between gender, race and age influence engineers' perceptions of diversity in engineering organizational culture?

To investigate these questions, particularly to gain a general understanding of engineers' perceptions as well as an in-depth understanding of individual perceptual differences due to gender, race/ethnicity and age, a mixed methods research paradigm was used. The quantitative research methodology that employed an engineering workplace climate survey was sequenced before the qualitative methodology. The population for the survey is engineers who are deemed qualified to practice as professional engineers (PEs) by Pennsylvania and the National Council of Examiners for Engineering and Surveyors. Additional information about the sample population, survey logistics and response rate is presented in Chapter Three. The results from the survey identified a purposeful sub-sample of eight female engineers who were selected for the qualitative semi-structured interview portion. Additional information about the interviewee selection criteria and the findings from the qualitative portion of the study are presented in Chapter Five.

The quantitative data were collected by an engineering workplace culture climate survey. As discussed in depth in Chapter Three, the survey was developed using a variety of resources

including a professional workplace climate survey (Rassmussen, 2007), two research-based instruments (Ioannou, 2008; Murphy, 2005) and questions developed by the researcher that reflected the literature on women in engineering and organizational learning (Gardiner, 1999; Gatta & McKay, 2003). These questions were grouped into seven theoretical dimensions that were based on diversity and organizational learning literature (Gardiner, 1999; Gatta & McKay, 2003; Ioannou, 2008; Murphy, 2005; Rassmussen, 2007). Those dimensions are: (1) recruitment, (2) retention, (3) communication, (4) leadership, (5) interpersonal climate, (6) learning environment and (7) employee engagement. In addition, the survey contained demographic descriptors such as gender, age, race, amount of time in the profession, and type of degree. Descriptive statistics were performed to get a general picture of the overall sample characteristics. The gender, age and race characteristics of the sample are shown in Table 2.

Table 2

Characteristics of the Sample

	Number of Responses	Percent
Gender		
Female	238	45
Male	289	55
Age		
30 and under	9	2
31 - 40	105	20
41-50	160	30
51-60	152	29
> 61	99	19
Race		
White	486	94
Non-white	33	6

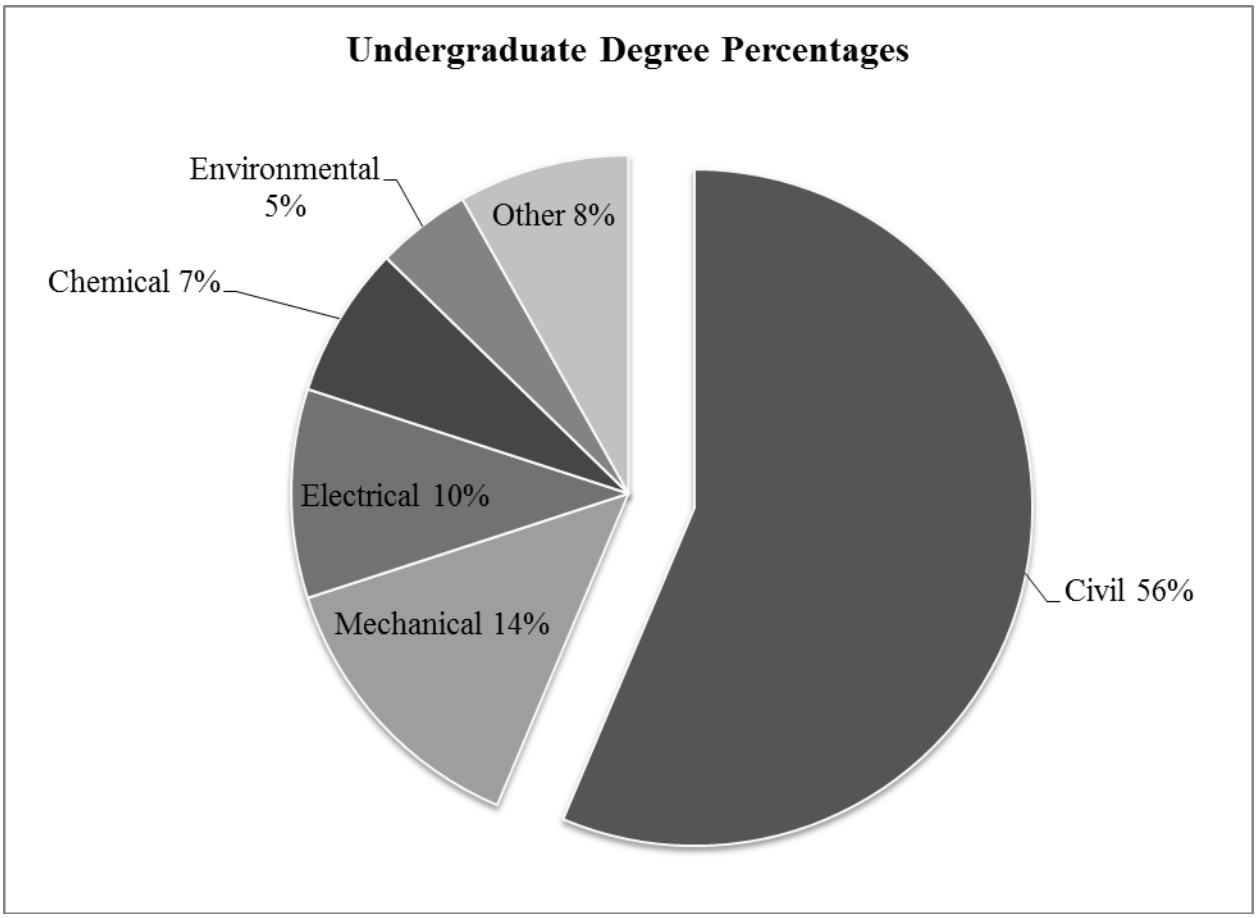
As discussed in Chapter Three, particular attention was paid to ensure an adequate female sample size to test for correlations between the theoretical dimensions and the variable of gender. As indicated, of the sample, 45% are females and 55% are males. While the age variable produced a near equal distribution across the top four brackets age brackets, only 2% of the sample is in the 30 and under category. Additionally only 22% of the sample is age 40 or under while 78% is over the age of 40 and approximately 48% or half of the sample is over the age of 50. Furthermore, roughly 70% of respondents indicated they have been working in engineering for 20 years or more. To clarify the meaning of this data, the requirements to become a professional engineer usually include obtaining an undergraduate degree in engineering from an Accreditation Board for Engineering and Technology (ABET) approved academic program, passing the Fundamentals of Engineering exam, then four years working in engineering with direct tutelage under a professional engineer and finally passing an professional engineer exam. Although these age distributions may not necessarily be indicative of the general non-PE engineering population (people usually do not achieve the status of PE until their late 20's or early 30's), the percentage distribution of sample age could indicate an aging workforce that lacks younger engineers available to fill the gap. Additionally, research does indicate an overall downward trend in undergraduate engineering degrees (Gibbons, 2008). The remainder of this chapter will first present the demographic data of the survey respondents. Next, engineers' overall perceptions (without distinction of demographic differences) of the diversity scales will be discussed. Finally, the results of the hypotheses tests, including differences in perceptions by gender and age and the predictor value of gender and age of the diversity measures as well as the predictor value of six of the diversity measures for employee engagement will be discussed.

Demographics

It was the intent of this study to examine differences in engineers' perceptions using race as an independent variable, but as indicated in Table 1, the lack of racial diversity in the sample prevents any such statistical analysis. Given that the underrepresentation of people of color, particularly African Americans and Hispanics, in engineering is well documented, it was predictable that the racial diversity of the sample population would be low; the population of people of color in the current study is 6 %. Although female engineers are also known to be underrepresented (Bureau of Labor Statistics, 2008b; Department of Commerce, 2011) it was possible to view the list and stratify the sample to ensure an adequate sample size of women. Unfortunately, due to lack of information regarding race or ethnicity of the sample population, it was not feasible to identify and thus select people of color to ensure an adequate sample size. Therefore, the data presentation and discussions concerning engineers' general perceptions for the seven dimensions from the survey primarily reflect white male and female engineers' perceptions.

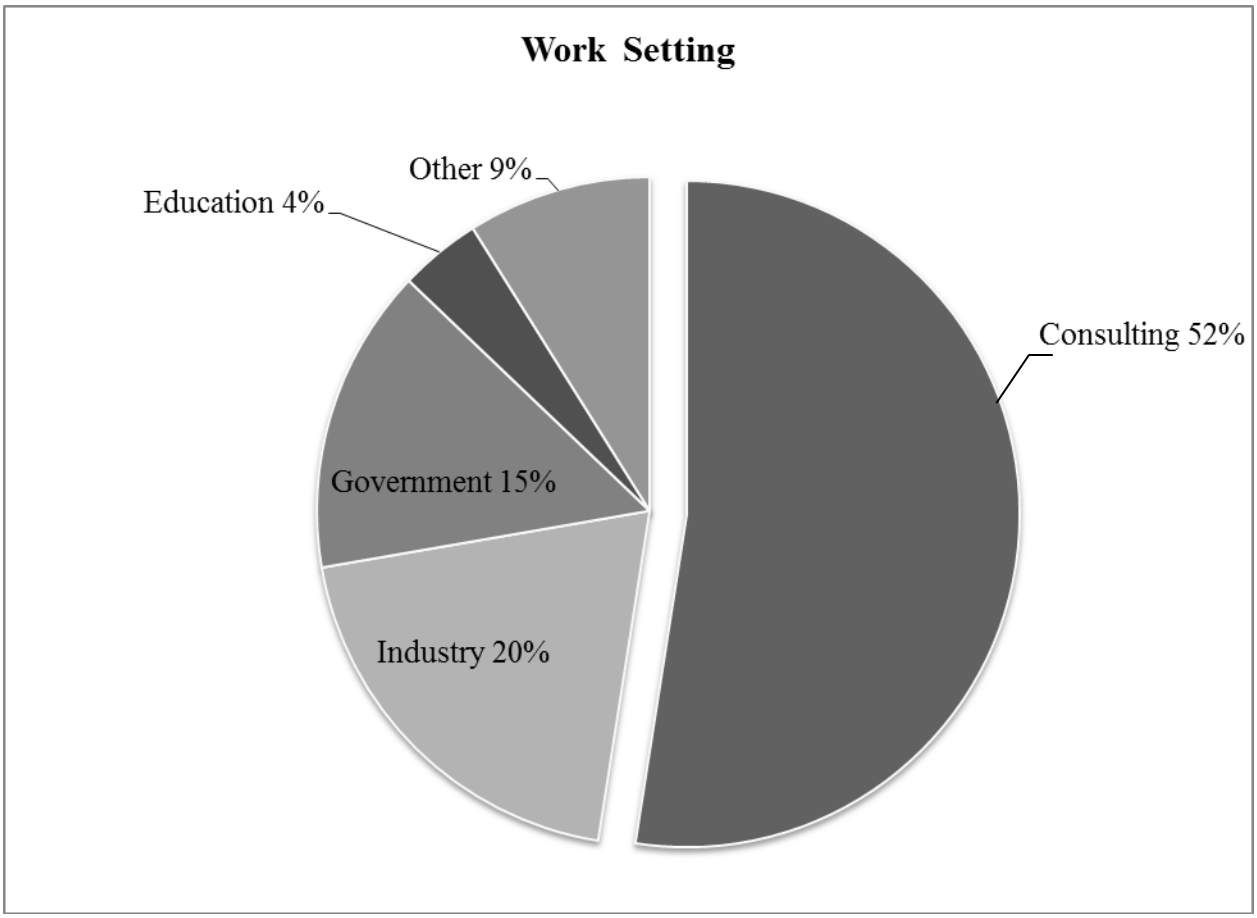
Other characteristics that describe the sample are the undergraduate engineering degree make-up (shown in Figure 1), and the type of work setting (shown in Figure 2) represented by the sample.

Figure 1 Undergraduate Degree Percentages



Over half of the engineers had undergraduate degrees in civil engineering, while those receiving degrees in mechanical, electrical and chemical were 14%, 10% and 8% respectively. Those with environmental engineering degrees represented the smallest group at 5% and 9% indicated a degree other than those listed.

Figure 2 Type of Work Setting



The majority of respondents worked in consulting firms (52%), 20% in industry and 15% in the government. Those who worked in education represented the smallest portion (4%) while 9% indicated a working environment other than the ones identified.

Finally, the greater part of the respondents indicated they were married (84%) and that their spouse worked full-time (61%). Eight three percent of the overall sample responded that they had children. Given that 78% of the sample are between the ages of 41 and 60 or older, it is not surprising that 24% indicated their children were between the ages of 10 and 18 while 54% have children over the age of 18. The next section will present the engineers' responses in the form of distribution frequencies for the survey questions. Note that the percentages may not

equal 100 due to rounding error. The data is presented in tables organized by the seven theoretical dimensions. Additionally, to test the hypothesis about differences in perceptions by age and gender, the dimensions were collapsed and indices were created. The range, mean and standard deviation of the indices are also presented. Recall that each survey question was evaluated on a four point Likert scale. When creating the indices, it is customary to recode the Likert scale to a starting point of zero. Therefore, if a dimension contained five questions and the scale would run from 0 to 3, the theoretical range would be 0-15.

Engineers' Overall Perceptions of Diversity

The seven theoretical dimensions included in the engineering workplace climate survey are: (1) recruitment; (2) retention; (3) communication; (4) leadership; (5) interpersonal climate; (6) learning environment; and (7) employee engagement. Each dimension consists of five to nine questions with responses indicated on Likert-type scales ranging from strongly disagree to strongly agree. Scale reliability was conducted on each of the dimensions; the individual questions that related to each dimension were analyzed for internal consistency reliability using a Cronbach's alpha value of > .7 as the determining factor. This ensured that the questions were sufficiently related to each other to be measuring the same concept. Although acceptable alpha values are debatable, George and Mallory (2009) provide the following rules of thumb "> .9 – Excellent, > .8 – Good, > .7 – Acceptable, > .6 - Questionable, > .5 – Poor, and < .5 – Unacceptable" (p. 231). For all seven theoretical dimensions, an alpha of .7 or greater was obtained. As noted above, the initial presentation of these findings are for the respondents overall without consideration of differences in perceptions due to gender or age. Those results that take the differences in the sample population will be discussed in a later section.

Recruitment Scale

The first dimension that relates to an organization's/company's attention to diversity is recruitment practices. Recruitment refers to the organization's ability to recruit underrepresented employees such as women or people of color. Underlying that sentiment is the intention of recruitment practices, for example, are nontraditional employees being actively recruited through alternative means? As indicated in Table 3, the recruitment scale contained five questions.

Table 3

Recruitment

Questions	Strongly Disagree	Disagree	Agree	Strongly Agree
Successfully recruits for diverse employees	3%	19%	57%	22%
Has diverse employees at all levels	7%	36%	41%	17%
Ensures a diverse applicant pool when filling a vacancy	5%	29%	50%	16%
Encourages diverse employees to apply for internal positions	3%	19%	58%	20%
Uses nontraditional networks (social networks, minority organizations) when advertising vacancies	21%	47%	25%	6%

Although most of the respondents indicated that current recruitment practices paid attention to diversity, the discrepancy in the perception of adequate recruitment practices and the visibility of diverse employees at all levels is interesting. While 40% indicate that diverse individuals are present at all levels of the organization, a high percentage, 36%, disagree. Given that

engineering is known for an underrepresentation of women and people of color, particularly at higher levels, it is surprising that 41% of the sample perceived that diverse individuals are present at all levels of their organization. Perhaps the most controversial question and interesting result for the recruitment variable is the indicated lack of selective and intentional recruitment practices, such as using nontraditional networks, for nontraditional or underrepresented individuals. Although one of the best recruiting practices to ensure a diverse applicant pool is to target sources of underrepresented applicants through outlets that cater to minority populations (McKay & Avery, 2005), it appears as if the culture of engineering conflicts with that philosophy.

Even though the survey did not include a place for comments, some respondents felt so strongly about this issue that they provided written comments on the survey that may clarify this view of recruitment practices. Frequently, these comments indicated an approach that was critical of affirmative action philosophy, especially any practice that involves preferential recruitment on the basis of race, gender, or ethnicity. All of these negative comments were from white respondents. One male engineer responded thusly, “My goal is to use the person best suited to the job. If a minority person doesn’t have the initiative to apply for a job at my company and instead waits for me to search them out, then they don’t have the initiative to do the work required at my company.” Another male comment that was indicative of this stance said, “I find this survey slightly offensive in the manner which questions are asked and presented. My company focuses on the employee regardless of race. Minorities are not given special consideration or excluded. This type of survey only furthers the problem.” Women also commented in the negative. One woman interpreted these practices as reverse discrimination saying:

> My company interviews and hires people based on their experience, skills and potential contribution to the organization, not based on demographic or to full-fill diversity in the company. My personal belief is in line with the company's. I actually think it is discriminating to hire someone based on their race, etc,

Some of the negative survey comments appeared to have more to do with resistance of the dominant group than a philosophical perspective. For example one male respondent commented, "The fact that you are doing a study on diversity and learning means you perceive a concern. My concern is if it's perceived, it must be true. The old saying is 'you can make numbers say anything you want.' " Similarly, a written comment from a male who refused to complete the survey had the perspective of "we just can't find any qualified nontraditional applicants" (Rasmussen, 2007 p17) which is a reinforcement of the assumption that there are no qualified nontraditional engineers. He said:

> Quite frankly, I had not responded because I found a number of your questions unethical and structured to lead to a purely one sided, predetermined conclusion. You had identified that the intent of your questionnaire was to contribute to an understanding 'of the multiple factors that result in the under representation of women and minority groups in science, technology, engineering and math (STEM) careers,' however, your questions focus on recruitment and treatment of these groups once employed and do not address more obvious factors such as whether or not employers see a representative pool of women and minority groups available for employment coming out of the university systems. Supply and demand works both ways and I'd recommend your study should reflect both, not just the resumption that the employers are not appropriately incorporating women and minority groups.

Fortunately, as the response rate indicates, not all engineers were quite as resistant and one male respondent explicitly referred to the change in demographics and geographic constraints as an impetus for organizations to support diversity initiatives saying, "[I am] CEO & COB of an ESOP owned company. In this region of the company, most, if not all companies have to recruit from diversity as too few white American males are available in our discipline."

The recruitment scale yielded a Chronbach's alpha of .809. An index titled *recruitment* was then created by summing the scores across each of the five questions. This produced a range of 0-15 with a mean of 8.5 and a standard deviation of 2.9. The theoretical dimension of retention, the organization's ability to retain underrepresented employees, is closely associated with recruitment and is particularly important in this study due to the reported higher percentage of women compared to their male counterparts who are not being retained in engineering employment (Freehill, 2008).

Retention Scale

Companies that make efforts to recruit nontraditional employees but fail to examine invisible structural inequalities may experience a higher turnover rate for minority employees due to an unfriendly culture. Effective retention strategies include supportive, inclusive environments that pay attention to professional development with clear performance expectations and constructive feedback about performance (McKay & Avery, 2005). Good retention practices are also implicated in employees' perceptions of employee engagement or job satisfaction. Theoretically, if people feel that they: (1) receive the proper education/training to be successful in their current jobs that also supports growth in their careers; (2) receive valuable feedback; (3) are being treated fairly; and (4) have visible examples of people they can identify with who are

successful, they will be more satisfied in their positions. The percent responses for the dimension of retention, which contained seven questions, are presented in Table 4.

Table 4

Retention

Questions	Strongly Disagree	Disagree	Agree	Strongly Agree
Strongly encourages professional development for all employees	3%	15%	41%	41%
I receive valuable feedback on my performance	4%	18%	57%	21%
People are rewarded based on performance	8%	20%	51%	22%
Does a good job of addressing performance problems	7%	37%	45%	11%
Benefits are equal regardless of employee group	3%	16%	45%	36%
No difference in turnover rate of diverse employees	3%	13%	59%	26%
Maintaining a diverse staff is important in fulfilling company's mission and goals	7%	35%%	45%	13%

In general, company retention practices that are effective in retaining diverse employees were perceived favorably. Over 80% of responses indicated that professional development was strongly encouraged and near 80% perceived they received valuable feedback on their performance and that employees were rewarded based on performance. However, 44% disagreed that their company did a good job of addressing performance problems. Given these

statistics, there seems to be a difference in how engineers perceive retention strategies affecting them personally and other employees. Finally, nearly half the sample (42%) indicated that maintaining a diverse staff is not important in fulfilling their company's mission and goals which is a clear indication that diversity is not a priority at the highest levels. Articulating the company's commitment to diversity initiatives and the value that is placed on having a diverse workforce is examined through leadership behaviors and company communications. The retention scale yielded a Chronbach's alpha of .803. An index titled *retention* was then created by summing the scores across each of the seven questions. This produced a range of 0-21 with a mean of 13.4 and a standard deviation of 3.7. The next section will look at engineers' responses for the dimension of communication followed by the leadership dimension.

Communication Scale

Communication refers to the quality of communication within the organization that supports inclusion and articulates a shared mission and goals. Effective communication has been identified as a positive attribute in learning organizations and critical feminist frameworks that favor examining discourse for exclusionary language, inconsistent messages and how it serves to deny or reinforce natural assumptions (Gardiner, 1999; St. Pierre, 2000). Table 5 presents the percentage response data for the six communication survey questions.

Table 5

Communication

Questions	Strongly Disagree	Disagree	Agree	Strongly Agree
Leadership clearly communicates company's directions and goals	4%	17%	58%	22%
Leadership communicates how things are going in the company	3%	15%	61%	21%
Company communication reflect diversity represented by employees, customers and the community	3%	19%	62%	21%
Comfortable expressing my ideas and concerns	2%	11%	59%	28%
Discussing difficult issues related to diversity is accepted	3%	18%	66%	14%
Employee behavior is consistent with company's diversity policy	3%	12%	74%	12%

The majority of engineers from the sample agreed or strongly agreed that workplace communications supported learning and/or inclusion and diversity. For example, approximately 80% of the sample indicated that leadership communicates the company's goals and current operating status and that discussing difficult issues such as diversity is accepted. Over 80% of the respondents feel their company reflects the diverse nature of employees, customers and the community. However, since engineering employees appear to be overwhelming white and it is

not clear that the customers or the community in which the company does business have significant racial or ethnic diversity, these results may very well indicate that communications are simply reflecting a traditional white majority paradigm. Similarly, although 85% think employee behavior is consistent with the company's diversity policy, it is unclear whether a majority of companies even have a diversity policy (in the following section that discusses the leadership scale, 42% do not think that maintaining a diverse staff is important to the company's goals and mission and 40% disagree or strongly disagree that valuing diversity is part of the company's mission statement and supported by policy). It is important that company leaders champion inclusion of diversity in a company's mission and goals and communicate a diversity policy. The communication scale yielded a Chronbach's alpha of .839. An index titled *communication* was then created by summing the scores across each of the five questions. This produced a range of 0-18 with a mean of 11.9 and a standard deviation of 3.0. While the theoretical dimension of communication includes questions about communications that originate from leadership as well as general communications within and outside of the organization, the perception of how effective leadership is in promoting diversity and learning was also measured.

Leadership Scale

The construct of leadership is important because it incorporates a critical feminist understanding of the role of power, structure, and leadership in diversity initiatives. Additionally, research indicates that in order for organizational culture to become more inclusive and place value on having a diversified workforce, the message must be strongly supported and modeled by leadership (Cox, 2001; Rassmussen, 2007). Table 6 presents the sample responses for the eight questions that measure how effective leadership is at supporting inclusive environments and promoting and valuing diversity.

Table 6

Leadership

Questions	Strongly Disagree	Disagree	Agree	Strongly Agree
Company leaders are role models for valuing diversity	5%	21%	61%	14%
Leadership has removed or are working to remove roadblocks to inclusion and valuing diversity	2%	20%	61%	17%
Valuing diversity is a part of mission statement and supported by policy	6%	33%	46%	15%
There are role models that I can identify with	8%	20%	55%	18%
Company leaders are excellent sources for coaching and modeling	7%	31%	50%	12%
Decisions are made at the highest levels without soliciting feedback from employees	4%	31%	44%	21%
Supervisor listens when I have something important to say	3%	7%	56%	35%
Supervisor treats me with respect even when I make a mistake	3%	6%	55%	36%

For the leadership questions that relate to diversity, the responses are favorable (>70%) and indicate that company leaders are role models for valuing diversity and working to remove

roadblocks that inhibit the company's diversity. However, close to 40% either disagree or strongly disagree that diversity is valued in the mission statement and policy of their company. Additionally, although 73% indicate that role models they can identify with exist, only 62% say leaders are excellent sources for coaching and modeling. Although over 90% of engineers feel respected in their positions and indicate that their supervisor listens to them, approximately 65% say that they work in a hierarchical environment where employees have little input on company decision making. The leadership scale yielded a Chronbach's alpha of .830. An index titled *leadership* was then created by summing the scores across each of the eight questions. This produced a range of 1-24 with a mean of 14.5 and a standard deviation of 4.1. Since flatter organizational structures can be associated with environments that support learning and growth, these results indicate that most engineering workplaces are still structured in a very traditional top-down model that may hinder communications, create barriers between leadership and employees and provide less flexibility for employees. Leadership's ability to communicate value for diversity, inclusiveness and respect for all employees regardless of their position, gender, race, age, etc. is related to the interpersonal climate, another measure of an organization's ability to provide an environment or workplace culture where all employees feel valued and respected.

Interpersonal Climate Scale

How employees relate to each other and how comfortable they feel about their personal characteristics or positionalities and the culture of their organization is measured via the interpersonal climate scale. Five questions were used for this scale and the results for those questions are presented in Table 7. The interpersonal climate scale yielded a Chronbach's alpha of .835. An index titled *interpersonal climate* was then created by summing the scores across

each of the eight questions. This produced a range of 2-27 with a mean of 17.6 and a standard deviation of 4.4.

Table 7

Interpersonal Climate

Questions	Strongly Disagree	Disagree	Agree	Strongly Agree
I feel respected as a person in my job	3%	8%	53%	37%
Company is inclusive of all people	2%	14%	56%	28%
I have never witnessed excluding behavior such as derogatory jokes, stereotypes, etc.	12%	42%	34%	12%
Company maximizes potential growth for all employees	5%	29%	50%	16%
Creates an environment where all people can be successful regardless of their diversity	4%	12%	60%	24%
Diverse individuals who are promoted are respected in their new positions	2%	8%	71%	18%
Some groups lack access to informal activities (after work engagements, golf outings, hunting trips, etc.) that negatively affect their advancement	25%	54%	17%	4%
Had to change appearance to fit in	27%	59%	13%	1%
Provides job flexibility such as working at home or compensatory time	10%	21%	48%	21%

From the results of the survey questions, engineering employees apparently feel their interpersonal culture is inclusive and welcoming to diverse individuals. A majority feel respected in their jobs and perceive that the climate/environment is such that all employees can succeed and that nontraditional individuals who are promoted are respected in their new positions. Approximately 80% disagree that they have had to change their appearance or that some groups lack access to activities that could enhance their advancement. According to the research literature presented in Chapter 2, an important consideration for female employees who are raising families or taking care of elderly parents is job flexibility. Approximately 70% of engineers indicate their job does provide flexibility in the form of working at home or taking compensatory time. However, 54% indicate that they have witnessed excluding behavior and over 30% do not feel that the company maximizes growth for all employees. Although maximizing growth can be accomplished in a number of ways, it is frequently demonstrated by offering opportunities for employees to learn through professional development or informal learning opportunities and support through mentoring relationships.

Learning Scale

Opportunities to learn, engage in professional development for self improvement and learn about the importance (and reality) of diversity is a major contributor to changing an organization's culture from exclusionary/traditional to one that is inclusive and supports nontraditional employees. The survey results for the nine questions that measure the learning environment can be found in Table 8.

Table 8

Learning

Questions	Strongly Disagree	Disagree	Agree	Strongly Agree
Company values learning about diversity	4%	30%	55%	10%
I have had an opportunity to examine my own assumptions about and stereotypes about diversity	2%	31%	60%	7%
All employees receive diversity training	16%	43%	27%	15%
Makes sure all employees have the skill to work with diverse groups	9%	42%	44%	6%
Values social/relationship skills as well as technical skills	3%	18%	63%	16%
Encourages learning through mentoring relationships	5%	23%	54%	18%
It is important to learn the unwritten rules to get ahead	6%	47%	37%	10%
Diverse employees take advantage of professional development opportunities at the same rate as traditional employees	2%	13%	71%	15%
Most of my learning is done “on the job”	<1%	18%	63%	18%

The theoretical dimension of learning encompasses an organization’s ability to encourage and foster a positive learning environment, particularly in regards to diversity issues. Helping people learn about cultural competency and diversity in organizations is usually difficult because it is a

relatively new competency and is particularly difficult in engineering where learning is usually associated with technical knowledge. Engineering employees appear to be divided on how they perceive their organization's leaning environment. For example, while over half agree or strongly agree that their company values learning about diversity, 34% disagree or strongly disagree. Perhaps the most illuminating result is that 59%, more than half of the respondents indicate that all employees do not receive diversity training and they are split on whether the company makes sure that employees have the skill to work with diverse groups. Interestingly, almost 79% of engineers think their employers value social relationship skills as well as technical skills and approximately 72% indicate learning is encouraged through mentorship, but almost half indicate it is important to learn the unwritten rules, politics and culture of an organization to get ahead. Also, the survey provided no insight as to whether employees had mentors and how successful those relationships may have been. Finally, over 80% indicate that their learning is primarily on the job or that learning about the job occurs while they are actually engaged in the work activity. Although on the job learning is a part of most employment, especially in technical fields where learning by doing is the norm, it is not clear that employees can learn about diversity on the job or through mentoring relationships, especially when little diversity currently exists in engineering. The learning scale yielded a Chronbach's alpha of .71, the lowest of the scales but still acceptable according to the literature previously cited. An index titled *learning* was then created by summing the scores across each of the eight questions. This produced a range of 3-25 with a mean of 15.5 and a standard deviation of 3.5. Ultimately, the goal is to have employees who are engaged in their jobs and satisfied with their career choice.

Employee Engagement Scale

The final dimension, employee engagement, is a measure of how satisfied and committed an employee is to their position and the organization. The results of the seven questions that represent employee engagement are presented in Table 9.

Table 9

Employee engagement

Questions	Strongly Disagree	Disagree	Agree	Strongly Agree
Generally, I am very satisfied with my job	<1%	18%	63%	18%
Satisfied with the balance between the responsibilities of my work and personal life	3%	17%	59%	21%
Feel comfortable taking time off to deal with a family or personal issue	3%	13%	52%	33%
Company inspires me to do my best in the way of job performance	3%	14%	55%	29%
Really care about the future of my company	<1%	7%	51%	41%
In general, I don't like my job	50%	44%	5%	2%
Willing to go above and beyond what is normally expected to help my company be successful	<1%	5%	53%	41%

The good news is that engineers overwhelming report that they are satisfied with their career choice. Over 90% indicate that they like their job and over 80% report that they are satisfied

with their job. For questions related to their commitment to the company, over 90% say their company inspires them to do their best in performing their job responsibilities and that they are willing to go above and beyond normal expectations. Slightly less, approximately 80% indicate that they are satisfied with the balance between their personal and professional life and that they feel comfortable taking time off work to deal with a personal issue. Recall that the survey sample consists of 55% men and 45% women. In general, these results seem to contrast with previous research and an engineering grand narrative that indicts work environments that are not flexible or unfriendly to families for the lack of women entering engineering or opting out at higher rates than their male counterparts (Frehill, 2007; Koehler, 2008; Marjoram, 2003). The employee engagement scale yielded a Chronbach's alpha of .850. An index of *employee engagement* was created with a range of 2-21 and a mean of 15.5 with a standard deviation of 3.4. To test the hypothesis and investigate differences in perceptions of female engineers and male engineers, the next section will discuss the process involved in reducing or collapsing the data into seven indices for the correlation and regression analysis. The data is presented and discussed as it relates to the testing of the quantitative hypotheses. Additionally, a multivariate statistical analysis was run to examine the extent that the created indices are predictors of employee engagement.

Hypothesis Testing - ANOVA

The seven theoretical dimensions included in the engineering workplace climate survey are: (1) recruitment, (2) retention, (3) communication, (4) leadership, (5) interpersonal climate, (6) learning environment and (7) employee engagement. As discussed previously, the individual questions that related to each dimension were first analyzed for internal consistency reliability using a Cronbach's alpha value of > .7 as the determining factor. Once it was determined that

there was internal scale reliability, questions were collapsed to create an index that directly reflected each theoretical dimensions, for example a *recruitment* index, a *retention* index, a *communication* index, etc. The hypotheses for this portion of the study are:

H1 Males are more likely than females to hold positive perceptions of recruitment.

H2 Older engineers are more likely than younger engineers to hold positive perceptions of recruitment.

H3 Males are more likely than females to hold positive perceptions of retention.

H4 Older engineers are more likely than younger engineers to hold positive perceptions of retention.

H5 Males are more likely than females to hold positive perceptions of communication.

H6 Older engineers are more likely than younger engineers to hold positive perceptions of communication.

H7 Males are more likely than females to hold positive perceptions of leadership.

H8 Older engineers are more likely than younger engineers to hold positive perceptions of leadership.

H9 Males are more likely than females to hold positive perceptions of interpersonal climate.

H10 Older engineers are more likely than younger engineers to hold positive perceptions of interpersonal climate.

H11 Males are more likely than females to hold positive perceptions of the learning environment.

H12 Older engineers are more likely than younger engineers to hold positive perceptions of the learning environment.

H13 Males are more likely than females to hold positive perceptions of employee engagement.

H14 Older engineers are more likely than younger engineers to hold positive perceptions of employee engagement

H15 Across the seven dependent variables associated with this project (recruitment, retention, communication, leadership, interpersonal climate, learning environment and employee engagement) gender will play a greater role at predicting respondents perceptions than will age.

H16 Controlling for gender and age, perceptions of retention will better predict perceptions of employee engagement than will perceptions of recruitment, communication, leadership, interpersonal climate and learning environment.

To test the hypotheses about differences in perceptions of the indices between men and women and by age brackets (H1 – H14), a one-way analysis of variance (ANOVA) test was run at 95% confidence level and was considered significant at a 0.05 or less p value. These results are displayed in Table 10. The means of the individual categories (male, female, 30 and under, 31-40, etc.) are only displayed where the results are statistically significant.

Table 10

ANOVA results for gender and age H1 through H14

	Range	Mean	SD	F	Sig (p value)
Recruitment	0-15				
H1 Gender		8.5	2.9	15.895	.000*
Female		7.9	3.0		
Male		9.0	2.8		
H2 Age		8.5	2.9	1.172	.322
Retention	0-21				
H3 Gender		13.4	3.7	29.596	.000*
Female		12.4	3.9		
Male		14.3	3.3		
H4 Age		13.4	3.7	2.429	.047*
30 and under		14.8	3.0		
31-40		13.0	3.5		
41-50		13.2	3.7		
51-60		13.4	3.8		
61 and over		14.5	3.7		
Communication	0-18				
H5 Gender		11.9	3.0	18.383	.000*
Female		11.2	3.2		
Male		12.4	2.8		
H6 Age		11.9	3.0	26.766	.019*
30 and under		12.8	2.0		
31-40		11.2	2.9		
41-50		11.8	3.1		
51-60		11.9	3.2		
61 and over		12.7	2.8		
Leadership	1-24				
H7 Gender		14.5	4.1	27.071	.000*
Female		13.4	4.1		
Male		15.4	3.8		
H8 Age		14.5	4.1	1.337	.255
Interpersonal	2-27				
H9 Gender		17.6	4.4	14.318	.000*
Female		16.8	4.7		
Male		18.3	4.0		
H10 Age		17.6	4.4	1.107	.352
Learning	3-25				
H11 Gender		15.5	3.5	20.385	.000*
Female		14.8	3.7		
Male		16.1	3.3		
H12 Age		15.5	3.5	2.335	.055
Employee Engagement	2-21				
H13 Gender		15.5	3.4	15.966	.000*
Female		14.8	3.6		
Male		16.0	3.2		
H14 Age		15.5	3.5	4.027	.003*
30 and under		15.9	3.4		
31-40		14.7	3.4		
41-50		15.4	3.2		
51-60		15.3	3.6		
61 and over		16.6	3.2		

* Denotes statistical significance at p = .05 level or better

For all of the indices, there was a statistically significant difference between the responses of female and male engineers. In other words, men and women had different perceptions about the factors that contribute to creating a diverse and inclusive work atmosphere. Although the mean female perceptions were favorable, they expressed less positive perceptions of recruitment, retention, communication, leadership, the interpersonal climate and the learning environment and they were less engaged as employees than their male counterparts. Therefore, hypotheses 1, 3, 5, 7, 9, 11, and 13 are accepted as proposed; males are more likely to hold positive perceptions of the seven indices.

For the variable of age, there was a statistically significant difference between the perceptions of age groups for three of the indices. Those indices are retention, communication and employee engagement. Furthermore, for these three indices respondents in the age categories of 30 and under *and* 61 and over appear to have higher perceptions than the middle three age groups. Therefore all the hypotheses for age (2, 4, 6, 8, 10, 12 and 14) were rejected. However, recall from Table 1 that the age category of 30 and under had a small total sample size (nine) compared to the other categories. Even so, it is interesting that those who are at the beginning of their career and those who are in the later stages of their career seem to have more favorable attitudes about the climate for retention, communication and employee engagement in current engineering environments. These results make common sense when one considers that young engineers may have more enthusiasm and excitement when starting out on their employment journey. They may not have the same burdens of growing families and climbing the career ladder that those in the middle experience. Additionally, it is likely that those in the midst of their careers have experienced some professional disappointment and loss of youthful ideals. Similarly, engineers in the later stages of their careers are probably looking forward to

retirement, have been relieved of the responsibilities that come with growing families and may have come to terms with lost opportunities and/or unrealistic youthful expectations. To further investigate the differences of perceptions by age, the categories of 30 and under and 31-40 were combined to create a 40 and under category with a total sample size of 114. The ANOVA test was re-run and the results are displayed in Table 11.

Table 11

ANOVA results for combined age 40 and under

	Range	Mean	SD	F	Sig (p value)
Recruitment	0-15				
H2 Age		8.5	2.9	1.240	.295
Retention	0-21				
H4 Age		13.4	3.7	2.567	.054
Communication	0-18				
H6 Age		11.9	3.0	3.299	.020*
40 and under		11.3	2.9		
41-50		11.8	3.1		
51-60		11.9	3.2		
61 and over		12.7	2.8		
Leadership	1-24				
H8 Age		14.5	4.1	1.230	.298
Interpersonal	2-27				
H10 Age		17.6	4.4	.672	.570
Learning	3-25				
H12 Age		15.5	3.6	3.119	.026*
40 and under		14.7	3.2		
41-50		15.4	3.5		
51-60		15.9	3.9		
61 and over		16.1	3.5		
Employee Engagement	2-21				
H14 Age		15.5	3.5	5.035	.002*
40 and under		14.8	3.3		
41-50		15.4	3.2		
51-60		15.3	3.6		
61 and over		16.6	3.2		

* Denotes statistical significance at p = .05 level or better

Combining the lower two age categories change the results slightly. When the two lowest age categories were combined, age proved statistically significant as a predictor of perceptions for

two of the same indices as before, communication and employee engagement. However, the index of retention was no longer significant while the index of learning was significant (in this case, hypotheses 6, 12 and 14 are accepted). Comparing the p values from Table 9 and Table 10, notice that the significance value for retention for the 30 and under group is .047, just slightly within the .05 level or better range. Combining the two lower age groups resulted in a slight increase of the p value to .054 where it fails to meet the criteria for significance. In the previous analysis, the index of learning had a p value of .055, slightly over the required level of .05. Combining the two lower age groups resulted in a more substantial change to .026 where it meets the criteria for significance. However, combining the two lower age categories resulted in lowering the mean value and obscuring the positive effect of the 30 and under group. Given the prior information, it seems reasonable that both the indices of retention and learning and the variable of age bear further relational analysis. Next the analysis for the final two hypotheses that examine the relationship between gender and age and the seven indices and the relationship of six of the indices (recruitment, retention, communication, leadership, interpersonal climate and learning), and the index of employee engagement is presented. For the final hypothesis age and gender were included as independent variables so that any influence they may have on the dependent variable of employee engagement is held accountable. This is a commonly referred to as controlling for independent variables that may cause interference in the interpretation of the model since the relationship between the dependent variable, in this case employee engagement, and each independent variable is examined individually while the other independent variables are held constant.

Hypothesis Testing – Multiple Regression

This study was also interested in examining the relationship between the demographic constructs of age and gender and the seven indices. In particular, hypothesis 15 states that gender will be a better predictor of engineers' perceptions of the seven indices than will age. The results of this analysis are presented in Table 12.

Table 12

Multiple regression results age/gender as a predictor of index perceptions H15

H15	B(std.)	Sig. (p value)	F	R^2 (adj.)	Sig.(model)
Recruitment			8.065	.031	.000
Age	.005	.922			
Gender	.186	.000*			
Retention			14.916	.056	.000
Age	-.011	.824			
Gender	.250	.000*			
Communication			9.506	.035	.000
Age	.050	.316			
Gender	.169	.001*			
Leadership			13.704	.054	.000
Age	-.026	.602			
Gender	.250	.000*			
Interpersonal			7.395	.027	.001
Age	-.041	.418			
Gender	.189	.000*			
Learning			10.894	.042	.000
Age	.060	.240			
Gender	.183	.000*			
Employee Engagement			9.269	.031	.000
Age	.079	.102			
Gender	.138	.004*			

* Denotes statistical significance at p = .05 level or better

In analyzing the ability to predict the responses based on gender or age, gender is significant as a predictor for all seven indices. In other words, the responses on the dependent measures of recruitment, retention, communication, etc. can be predicted by the independent variable of gender. Age proved not to be a significant predictor for the dependent measures. Therefore,

hypothesis 15 is accepted as proposed; gender will play a greater role at predicting respondents perceptions than will age across the seven dependent variables.

In as much as employee engagement is a measure of how satisfied and committed engineers are to their jobs and the organization, the presence of a predictor relationship between the six indices and employee engagement is valuable information and can help organizations focus their efforts to the best effect. Hypothesis 16 states that while controlling for the influence of gender and age, the independent variable of retention will play a greater role in predicting responses on the dependent variable of employee engagement than will perceptions of recruitment, communication, leadership, interpersonal climate and learning environment. Those results are displayed in Table 13.

Table 13

Multiple regression relationship of six indices controlling for gender and age on the perception of employee engagement

H16	B (std.)	Sig (p value
Gender	-.017	.656
Age	.121	.002*
Recruitment	-.179	.000*
Retention	.190	.003*
Communication	.122	.060
Leadership	.291	.000*
Interpersonal Climate	.370**	.000*
Learning	-.075	.153
F = 63.552		
R^2 (adj.) = .585		
Sig. (model) = .000		

* Denotes statistical significance at p = .05 level or better; ** Best predictor

Five independent variables tested significant in predicting perceptions of the dependent variable of employee engagement. Those are: (1) age; (2) recruitment; (3) retention; (4) leadership; and

(5) interpersonal climate. The standardized beta coefficient indicates which of the independent variable has the strongest relationship with the dependent variable. When examining the standardized beta coefficients in Table 13, the variable of interpersonal climate is the best predictor of employee engagement. Therefore, contrary to Hypothesis 16, retention is not the better predictor and Hypothesis 16 is rejected as stated. Other interesting results include the negative relationship between the index of recruitment and employee engagement which suggests that less favorable perceptions of recruitment practices may predict more positive perceptions of employee engagement. This result supports the prior discussion about survey respondent's negative comments regarding recruitment practices that are selectively designed to enhance the possibility of nontraditional job applicants. Additional discussion of the apparent resistance to intentional effort in widening the applicant pool or the assumption that engineers and engineering does not suffer from prejudice will be presented in Chapter Five. Finally, examination of the R squared value indicates that approximately 59% of the dependent variable (employee engagement) variance can be predicted by the significant independent measures.

Summary

This chapter presented the quantitative findings of an engineering workplace survey. The demographic analysis supported previous reports that people of color are underrepresented in engineering. The findings also suggest that overall engineers' (primarily white male and female) perceptions of the engineering workplace culture are positive. However, there appears to be a lack of diversity training and support for diversity at the leadership level. Additionally, engineers' do not seem to agree with recruitment efforts that are specifically designed to target underrepresented populations. It was also determined that male engineers perceive the workplace climate more favorably than their female counterparts. While gender was a

significant predictor for all of the climate indices, age proved to be a significant predictor for retention, communication and employee engagement. Finally, of the five indices that were significant in predicting employee engagement, interpersonal climate was the strongest predictor. These findings informed the qualitative portion of the study. The next chapter will present the findings obtained from the qualitative interviews. Since the current study used a mixed methodology where the quantitative data were collected and reviewed prior to the qualitative portion, connections between the quantitative findings and the qualitative findings will be referenced when relevant.

CHAPTER FIVE: QUALITATIVE FINDINGS

The purpose of this research study was to investigate engineers' perceptions of diversity and the workplace learning environment surrounding diversity education efforts in engineering occupations. The research questions that guide this study are:

1. To what extent do engineers perceive that engineering worksites foster learning about diversity issues related to gender, race/ethnicity and culture?
2. What are engineers' perceptions of diversity in engineering workplace culture?
3. Do interactions between gender, race and age influence engineers' perceptions of diversity in engineering organizational culture?

To investigate these questions, particularly to gain a general understanding of engineers' perceptions as well as an in-depth understanding of individual perceptual differences due to gender, race/ethnicity and age, a mixed methods research paradigm was used. Initially, an engineering workplace culture climate survey was sent to engineers to assess their perceptions of seven theoretical dimensions that relate to the diversity climate in engineering workplaces as well as to collect demographic information such as gender, age, race/ethnicity, etc. The survey also contained a question about participants' willingness to be interviewed. The population for the survey is engineers who are deemed qualified to practice as professional engineers (PEs) by Pennsylvania and the National Council of Examiners for Engineering and Surveyors. Additional information about the sample population and survey logistics is presented in Chapter Three. The results of the quantitative analysis can be found in Chapter Four. What follows is a discussion of the sample selection for the qualitative interviews and the interview process. After that the four primary themes of the qualitative findings are presented, namely that: a) attention to diversity was affected by the size and scope of the organization; b) that they specifically have chosen to be

in organizations that are more flexible and family-friendly; c) that they see engineering as neither above racial or gender prejudice; and d) that they continually experienced and deconstructed gendered expectations in themselves and others.

Qualitative Participants

The selection of the interview participants was influenced by the theoretical framework as well as the survey results. This study was grounded in a critical feminist perspective that attends to the issue of gender and is also interested in the intersection of multiple sites of oppression such as gender, race, age, etc. Therefore, the perceptions and experiences of women and women of color who work in engineering were particularly important in investigating the issues of diversity and learning about diversity and inclusive environments in a traditionally male occupation. From Chapter Four, the survey results revealed that there is a statistical difference between the perceptions of female and male engineers; women are less positive about the engineering culture climate than their male counterparts. Additionally, the qualitative methodology sought to gain an in-depth understanding of women whose experiences were markedly less positive about the current engineering climate. Another area that this study attends to is how and if age affects perceptions and/or is a source of oppression. The survey findings in Chapter Four identified areas where there is a predictor relationship between age groups and perceptions. Referring to the findings where all age categories are present, the three diversity indices where age is significant as a predictor of perceptions are retention, communication and employee engagement. Older engineers, those in the 61 and over age group and younger engineers, those 30 and under have more positive perceptions for these indices.

Initially, the group of potential interview candidates was those who self-identified as women and agreed to be interviewed. This list was then examined for women of color. Out of

the small sample size that indicated they were women of color, only two indicated a willingness to be interviewed. In order to select a minimum of eight female engineers to interview, the surveys were then examined for participants using two additional non-exclusive criteria deemed important in this study; those who were age 40 and below and those whose mean responses on the survey indices were below the female mean. While these non-exclusive criteria (with the exception of all the participants being female) resulted in an interview sample with less consistency than may be customary, each of the participants had perspectives that were important to the critical feminist framework and commonalities did emerge from the data. Additionally, the qualitative data analysis identified other sample selection criteria that was previously not considered noteworthy and appeared to result in commonality of experiences. For example, engineering occupational context appears to be a significant influence in diverging experiences and perceptions. This somewhat surprising discovery will be discussed further in Chapter Six. Finally, eight women were selected to be interviewed using the above non-exclusive criteria. Table 14 presents the demographic profile of the interviewees.

Table 14

Demographic information of interviewees

Alias	Race	Age	Current Organization Size and Scope
Deb	African American	41-50	Large corporate (US based) organization with domestic and global locations
Carol	African American	51-60	Small family owned consulting firm in Southeastern Pennsylvania
Cindy	White	51-60	Regional office Federal government agency
Glenda	White	31-40	Small family owned firm in Southcentral PA
Jane	White	41-50	Large international organization with global locations
Kara	White	31-40	Large organization based in Canada with multiple locations across North America
Margie	White	31-40	Co-owner , small consulting firm Southeastern PA
Nina	White	31-40	Large U.S. based organization with domestic and global locations

The qualitative data were obtained through the use of semi-structured interviews using an interview guide that was developed to increase the understanding of individuals' experiences of the diversity climate, the learning climate and how traditional invisible structures and assumptions affect diversity in engineering occupations. While the interview consisted of a standard list of questions, interviewees were free to broaden the discussion and non-standard follow-up questions were asked to clarify a specific topic of discussion. As discussed in Chapter Three, the transcripts of the interviews were analyzed for commonalities using the constant

comparison method. These commonalities are discussed according to their significance to the research questions.

The qualitative findings are organized in light of four main areas, (1) effects of organizational context: size and scope; (2) choosing employment in more family-friendly flexible organizations; (3) engineering as beyond neither racial or gender prejudice; and (4) dealing with/deconstructing gendered assumptions in self and others. Each of the areas has related sub-themes. The main areas and sub-themes are identified in Table 15 and discussed under the major heading area as they relate to the research questions, beginning with, “To what extent do engineers perceive that engineering worksites foster learning about diversity issues related to gender, race/ethnicity and culture?”, “What are engineers’ perceptions of diversity in engineering workplace culture?” and “Do interactions between gender, race and age influence engineers’ perceptions of diversity in engineering organizational culture?”

Table 15

Data Display: Themes and sub-themes

Theme	Sub-theme	Sub-theme	Sub-theme
Effects of Organizational Context: Size and Scope	*The Lack of Attention to Diversity in Smaller Organizations*	*Greater Attention to Diversity in Larger Organizations With International Scope*	
Choosing Employment in More Family-Friendly Flexible Organizations	*The Flexibility in Family Friendly Companies*	*Dissatisfaction with Family Flexibility in Prior Companies*	
Engineering: Not above racial or gender prejudice	*Women of Color Challenge Notion of Engineering as Unbiased*	*White Women Focus More on Engineering as Gendered*	*Younger Women Perceive Less Gender or Race Workplace Prejudice*
Dealing with/Deconstructing Gendered Assumptions in Self and Others	*Female Engineers Bear the Burden of Proof*	*Women of Color: Perceptions Differ*	*Gendered Expectations and Attributes of Engineers*

Effects of Organizational Context: Size and Scope

When specifically discussing diversity, for example, "What are the typical ways your organization communicates value for diversity?" organizational context appeared to be a factor in how the interview participants perceived their worksites fostered diversity and learning. As discussed in Chapter Three, other factors are also considered to be important in fostering diversity such as encouraging professional development, receiving valuable feedback on performance and the mentoring relationships. Although most of the literature on organizational learning identifies organizational structure, whether management is hierarchical or flat, as a significant factor in successful learning environments, the interview participants did not indicate

that either structure inhibited or facilitated diversity and learning. The context attributes that were most frequently mentioned or evident were size and scope. For the most part, the women who worked in larger organizations that were U.S. owned with international locations and those who worked in internationally owned companies with global locations perceived more support for and commitment to diversity than those who worked in small partner or family owned companies. However, in general, attention to professional development and mentored learning opportunities were lacking in all the organizations. Only three of the women (Margie, Deb, Jane) indicated satisfaction with their professional development opportunities. All of the women indicated that mentoring relationships were typically informal and only one, Margie, indicated that she currently engages in mentoring relationships. The influence organizational context exhibited on learning and diversity issues most often focused on were: (1) evidence of an official diversity policy; (2) strength of commitment to the diversity policy in terms of company action and intention or as Deb commented: "have actually done some work" in creating a diverse workforce; and (3) evidence of diversity training and professional development.

In general, the four female engineers (Jane, Deb, Kara, Nina) who worked for large organizations with an international scope (U.S. based or internationally based) perceived their organizations as more supportive of diversity. They expressed that the company had an official policy and diverse employees were visible, if not in their U.S. offices, through intra-net websites and video conference meetings. These women indicated that the visibility of other female and culturally diverse engineers was evidence that they would be able to succeed and be promoted in the organization. The one female engineer who worked in the context of the federal government, Cindy, reported mixed perceptions about federal agencies' commitment to diversity and learning. Conversely, the three female engineer (Glenda, Margie, Carol) s who worked in small, family-

owned firms that were geographically limited indicated that attention to diversity either through policy, action and the presence of diverse engineers was less evident or non-existent. The organizational context discussion starts with female engineers' experiences in smaller organizations. This discussion ends with the experiences of women working in large U.S. based or international organizations. As indicated previously, three of the women interviewed work in small, local and regional based engineering work sites.

The Lack of Attention to Diversity in Smaller Organizations

Small regional organizations that were partner or family owned appeared to have less awareness and lack of concrete evidence of attention to diversity such as policy and/or diverse employees. For example, Glenda, a white woman in the 31-40 age-bracket has worked for a number of small, regional and mostly family owned engineering firms in Southcentral Pennsylvania. She currently works for a small family-owned consulting company and has been there for about six years. Glenda indicated that there was little to no attention paid to diversity issues in any of the companies she worked saying, "I would say it doesn't even come on their radar screen." Additionally, she indicated that "there was hardly any written policy" and that in most of the small firms where she worked, employees learned the culture through deciphering the unwritten rules via observation and sometimes from informal mentoring relationships. With 20 years' of experience in four or five small family owned engineering firms, Glenda has never gone through a new employee orientation. She describes the work place atmosphere as one of trial-by-fire or sink-or-swim and connected that atmosphere to her experiences in the academic environment, particularly introductory courses in the engineering curriculum that are designed to weed out students saying:

> I've watched men and women come in and not do well…but I'm thinking, well you didn't train them. You hired a guy with a mechanical engineering background and you're complaining he can't do storm water design? I think that's a problem. I don't agree with that.

This type of culture that fails to provide adequate employee orientation training, feedback and/or job support (in adult education theory often termed as scaffolding) conflicts with some of the recognized traits of an organization that supports diversity such as a strong commitment to professional development, mentoring opportunities and providing valuable feedback that encourages individual growth as well as organizational growth. Glenda also indicated that her company does not encourage professional development or make employees aware of opportunities saying:

> They have never come to me. It's pretty much up to you to be valuable to the company. They don't see it as their job to promote you or educate you or keep you up to date. It seems to be up to you.

Although Glenda indicated she had learned via co-mentoring saying, "I've learned a lot from watching and talking with colleagues. More like a side to side rather than talk down or formal training." She also said those relationships were not structured noting, "I've never had a formal mentoring relationship in work and I've often thought that I would enjoy one. I've often wanted one."

When asked about her perception of diversity in general engineering workplace culture, Glenda indicated she did not think about it too much, but said:

> I would like it if there were more women in engineering. I'm currently the only female engineer. We did have a couple of other female engineers and it was nice to have some

> camaraderie. …I think it would be nice if there were more females I could socialize with or talk to or identify with.

Margie's situation is somewhat different. A white woman in the 31-40 age group, she is the co-owner (with her husband) of a small engineering firm. Although she acknowledged that women were underrepresented in engineering, Margie did not seem too concerned. While she indicated that in her experience engineering was mostly male, she did not attribute the lack of gender diversity to engineering culture climate, but perceived it was the because of the requirement for strong math and science skills and said, "Most girls just don't have an interest in it. …very few of my female peers had an interest in math and science…and they didn't perform well…it's not particularly fun sitting around doing calculations." The perception of gender influenced math and science interest/ability and their relationship to the engineering profession will be revisited in the discussion of gendered expectations and attributes of engineers. When asked her company's organizational characteristics and intention or commitment to diversity, Margie, said:

> Small was important. I'm not really sure…are you talking about diversity as far as male/female? I don't know that we specifically make a point to do that [show value for diversity], other than [speaking of herself] the main engineer and VP of the company is a female. We don't have a bound handbook. We have policies on things, but they are more related to…health insurance programs and things like that. I wouldn't specifically seek out a female candidate for a job to try and be more diverse or a certain ethnic background. Just whoever interviews the best and can relieve the stress and pressure on my life, that's what I'm looking for. I'm not looking for government contracts so the breakdown or the minority status of my company doesn't matter. We're not a minority

> owned company; we're only 50% so it hasn't been an issue for us. Currently we only have two females and nine males. Those seem to be the people that are qualified in…[CAD (computer aided drafting)] and engineering fields that we are working in.

Margie did indicate that she is supportive of her employees' professional development needs and noted:

> We have another professional engineer and both of us have to periodically go to continuing education courses to keep our license up. I have the CAD guy who has about 6 years' experience in CAD but wants to be an engineer. So I've been teaching him how to do a lot of the storm water planning and guiding him in his efforts to want to become an engineer. We're supporting him…we have tuition reimbursement to support him.

When asked about mentoring, she indicated that she saw it as her responsibility to mentor her employees (nothing formal) and has a valuable co-mentoring relationship with a male colleague.

The third woman who works in a small regional firm had a wealth of experience in a health related technical field before entering the engineering profession and unlike Glenda or Margie was very concerned with the lack of diversity in engineering. Carol, an African American engineer who currently works for a small locally owned consulting firm in Southeastern Pennsylvania has given the issue of diversity and learning at work quite a bit of thought. Because of her awareness of white privilege and gender discrimination as well as her level of maturity when entering the field, (age 43; currently in the 51-60 age group) she had an interesting perspective of the occupational dynamics around diversity and engineering. Speaking here of engineering in general as well as her own experiences, she said:

> I didn't worry so much about being around white men until I actually wound up around a lot of white men. And because I; you know it's funny it just never occurred to me that it was an issue that would have stopped me. I wondered later if I would have chosen a different degree if I had understood that it was so predominantly white. Period. White. I knew that there would be mostly men and I was kinda used to that, but it is actually mostly white men.

Speaking again about engineering in general, Carol perceived the interest in getting women in the field of engineering had more to do with political correctness and the desire to have a disposable, inexpensive workforce than gender equality, and notes:

> There is an expectation that the whole idea behind getting more women in the field is that there is a love of diversity. OK that was the pretense. It would be great to have a different mindset in the whole mix. Then when I watched how women were being actually treated…as far as training and moving forward; there would be a show of inclusion and I would watch women being sent to seminars and being sent to short-term courses to beef up their skill set and then they would come back and not get actual work in what they had gone away for. This would happen on a regular basis. It was so clear that you were there as a show of, 'see, we do have women in our company, it does matter.' But every single time, we tried to get mechanical room design, pipe design, you know, some of the more complicated design work, a lot of the younger men would almost always be assigned to it. In the end there was the promise of equality and the way that we were thought of as engineers and then there was the reality of it. …more often than not, it was the younger men who were moved in the direction of more and more responsibility and management roles and higher technical work, and women were

> generally in the design - meaning they didn't get a lot of management style offerings of many kinds, but were always doing support type of design work. After I left my previous job, I found out that all the women who had been working there…had been making a good 10-15% lower than the rest of the people in our field.

When discussing how organizational characteristics influence a company's commitment to diversity, Carol emphasized the importance of context, saying:

> I told my recruiters that I didn't want to work for a small firm anymore. That I didn't want to work for any firm that had less than 15 people. I told one recruiter that it was highly likely that if they were little or small they had no experience with diversity. And I was – like I was fed-up – I was really done with having to handle predominantly male and predominantly white with no sensibility of any kind. I said, 'Send me to companies that are large enough to have thought about diversity and worked it through, and actually have a program so that I can see that they have actually done some work.' Because there are a lot of small companies that don't think they have to do any work. See there is an interesting underlying premise in there that no effort is required. All you have to do is have good intentions and that makes it true. That is not so.

According to Carol, the concept of intention, action or doing work to ensure a more diverse work force was notably lacking in the smaller, regional and/or family owned companies. Carol expressed her commitment to her own personal development program and has invested her own time and money to increase her skill set to make herself a valuable employee. She said of her present and past experiences:

> I still have yet to work at an engineering company that has a structured way of doing reviews the way that you see outside of engineering - where you set goals for example.

> No one ever wants to set goals. In my interview he [current boss] complained, he had someone there who wanted him to sit down and to do career planning with him and describe where he should be when. And my current boss said 'I don't want to do that. I'll just let you run and see what you can do and I'll just add stuff and see how you can handle it and we'll just go on from there.' He didn't want to do anything structured or anything that he would be committed to or accountable for in any way.

She explained why, contrary to her previous remarks, she accepted a position in a smaller firm and in doing so, qualified her perceptions of the difference between a small company and a larger company with a global scope. Carol mused:

> Part of the reason I took this current job is that I knew the guys there – even though they were mostly white with a couple of Hispanic men – I understood that they had worked for [a large global science and research company] for a really long time and it is massive. And I've seen their documentation around diversity. I've seen the effort they put into developing diversity in their workplace, because they are big and they are worldwide and they had to figure that out. In order to be successful globally, they had to figure this particular piece out. Corporately they have very detailed standards.

As far as mentoring, Carol echoed Glenda's comments about the informality of the relationships relating, "I worked under a senior engineer… But it tends to be hit or miss. If you hadn't tucked yourself under somebody, you were sort of vulnerable."

The perceptions of the women who worked in small regional firms indicate those environments have a noticeable lack of awareness about diversity. Two of the women, Glenda and Margie did not seem too concerned about the lack of diversity in engineering in general. Although Glenda had thought about the issue, she seemed to have accepted the status quo in

small family operations. As co-owner of a company, attention to diversity, to use Glenda's phrase didn't even come on Margie's "radar screen." Carol on the other hand was very explicit about her thoughts on diversity in engineering in general and specifically discussed her perceptions about the difference between smaller versus larger company's attention to diversity and implied that an organization with a global scope by necessity had an increased awareness. Likely as a woman of color, she had more experience and awareness of invisible barriers and perceived attention to diversity as a way to bring those issues to light.

Greater Attention to Diversity in Larger Organizations with International Scope

There was greater perceived attention to diversity by those working in large and/or international organizations. Two of the women (Nina and Deb) work in U.S. owned/based organizations with a global scope. Jane and Kara work in internationally owned/based organizations. Cindy works for an agency in the U.S. federal government. Three of the five women indicated they were either satisfaction with their professional development opportunities or as in the case of Margie, was supportive of her employee's professional development.

Nina a female engineer under the age of 40 who works for a large U.S. owned company with multiple offices in the U.S. and around the world perceived her organization as being diverse in regards to gender and ethnicity. She stated:

> I think that we have a fairly multicultural office; a multicultural group. Surprisingly, the only person that I heard about folks having some trepidation about hiring was a white guy, because of his earrings. So, really anybody that showed up in a suit was fine. That seemed to stem a little bit towards what is our client going to think when they meet this person. If you have a Mohawk, then you can't go on a client meeting.

Nina works in environmental remediation and has spent her entire 10 year career with the same organization. She began her career in an office on the West coast but relocated to the East coast where she is currently based. Her main frustration with her job originated with what she perceived as the "corporate culture" and a disingenuous concern for the environment saying:

> We used to have a floating holiday and they bought another company so they took that away saying, 'oh we had to make these cuts to buy the other company', but they never put it back. They decreased the 401K match on the same rationale – 'Oh we're buying this other company' – but they never put it back. The company is all about how to turn a profit with the least amount of work you can do. [Also] there are an alarming number of people who are in the field that are really not – don't seem to be – environmentalist. They look at pollution as being a job security.

Despite these issues, Nina seemed satisfied with her company's attention to diversity and the evidence of diverse employees in the locations where she worked. When asked if there was more diversity displayed when she worked in California than in Pennsylvania she referenced the international scope of her organization saying, "No, not necessarily, because there is just as much diversity in the PA office as there was in the CA office. It's an international company, they have it as a policy 'We're diverse and we want to be diverse.'

Nina indicated that while professional development was available, those opportunities were most frequently available to middle and upper management level staff. The most common professional development opportunities available across the board were lunch-time seminars organized by vendors. When asked about her experiences with mentoring she confirmed previous remarks saying that it was a very informal system and up to the individual to find a suitable mentor. She related an example saying:

> Yeah, yeah there is nothing formal. We had a girl come in that was fresh out of school and she was pretty bored with the things she was working on and I sat down and I was like 'Look there's this guy in our group who is almost never in the office. He's a curmudgeon, he's old, he's going to retire, but he knows a lot of stuff' - and I was like – 'Go make friends with him.'

Deb works for a large U.S. owned organization with global locations. An African American woman in the 41-50 age group, when asked about why she thought engineering lacks diversity, Deb indicted a K-12 system did not emphasize engineering as a career by saying:

> It starts with people going to school; they are not introduced to engineering; 'what engineering is.' I was lucky enough to be introduced to engineering in the 8th grade. So I knew what engineering was and figured I wanted to pursue that.

Deb went on to also blame gender bias and gender socialization saying, "A teacher may be more inclined to try to get the boys into engineering rather than the girls."

Deb indicated that she recently changed jobs and specifically chose to work in her current organization because of their visible commitment to diversity demonstrated by a strong diversity and inclusion program in each of their divisions. She noted, "They had an African American woman in an upper management position to let me know that the glass ceiling had been broken." She spoke of her company's strong local and global commitment to diversity saying:

> They have a middle organization called America's D & I [diversity and inclusion, they also have an Asian D&I and a European D&I and they do different activities and then we have the diversity and inclusion leadership teams that focus on the local level. I am the chair for the D & I for GEO which is the local engineering organization. And we are

> trying to develop programs at that level. Then you have the American's developing programs at that level and the European's developing programs at that level as well.

When asked about mentoring opportunities, she referred to a single experience that had happened some years ago. Regardless of organizational context or scope, Deb was one of three women who were enthusiastic about her organization's support of a variety of professional development. She indicated that the company seeks input from employees and has been very transparent about the issues and work that needs to be done in creating an inclusive organization.

Similarly, Jane, a white female engineer (41-50 age group) with a 25-plus year career in engineering recently began working for an international consulting firm. Jane's general perception of diversity in engineering is that it is "typically Caucasian males." She also perceives that the underrepresentation of women is due to a lack of promoting engineering as a viable career path in the K-12 environment and says, "I'm not sure that they push – well not push – but promote engineering in schools as a viable career. I know girls are still not interested in math." Even though she works in a regional office in Western Pennsylvania, the company is internationally owned and she perceives much more support for diversity in her current organization that has a global scope saying:

> We have an intranet website and [current company] is a multinational company with offices in Australia, Russia, several offices in Canada, Brazil, Asia, and India. There is something on the website from every office and they change the website. You will see pictures of people that work in other offices and descriptions of the jobs they are working on and you get to see the people that work in the company. Although there are not a lot of women in Western Pennsylvania in engineering, it looks like in Canada that things may be somewhat different.

Like Deb, she described her current work environment as supportive of the financial and time commitment requirements for employees' professional development and involvement in local industry groups. Of mentoring she also referred to an experience that happened early in her career and spoke of how valuable it was saying, "I really learned a lot from those two guys. They had a lot of experience and they were pretty well known in the industry."

Kara, a white female engineer in the 31-40 age-group, currently works for a large oil and gas company based in Canada with multiple locations across North America. She left her previous company (U.S. owned) partly because of a lack of diversity. She explained her dissatisfaction with her previous company saying:

> I actually switched companies since I originally did the survey. And there is a big difference just between the two of them – between an American-based company and a Canadian-based company. The [previous company] was still very dominated by white males. In [current company] half of my group is technical females. And they are not right out of college. They are actually working moms, 35 to 40 year olds, with engineering degrees and doing engineering.

Kara emphasized the importance of a company's commitment to a diversity policy in terms of action and intention versus the political correctness approach to diversity or diversity as a marketing tool by saying:

> My previous company was famous for talking the talk but not walking the walk. They say they are one of the most diverse companies in the America and yes they do have about 50/50 [male/female ratio] but if you look at the technical side, it is like 10% and so they are great at walking the walk on like accountants and stuff but when I looked at my floor, other than the secretary there were two other girls and there were like 90 people on

> the floor. And so - yeah it happens and everybody is saying that it is no longer a white man's world but, not really. Most companies are still - they are hiding it, they are hiding it over in accounting or HR or somewhere else.

The only engineer that worked in a governmental position and one of the two women interviewed in the 51-60 age group is Cindy, who has worked in regional offices of three different federal government agencies for over 20 years. She currently works for the engineering specific agency where she started her career. Although all three agencies are within the purview of the U.S. federal government, Cindy related vastly different experiences of organizational commitment to diversity and learning about diversity. Cindy did not indicate whether or not her organization has an international scope, but she did refer to the importance of intention, policy and training in fostering diversity. When speaking about Agency A where she has spent most of her career and has returned to after being furloughed for a number of years, Cindy she had this to say:

> I know that A has goals for hiring diversity candidates. They look at the percentage of population. There is a percentage of women in the workforce, there is a percentage of women engineers; these should be our percentages within the [agency]. And they break it down by race; Hispanic, Asian, African American and they do try to meet those goals. What I see now is that in Agency A there are written policies, there are trainings in diversity, gender in the workplace that the other two agencies say they have but the emphasis really is not there.

In the two government agencies that she perceived lacked a commitment to diversity, Cindy felt she was discriminated against because of her gender saying:

> I was the only engineer in the group…I was supposed to be the engineering expert, but a lot of the designs that I came up with…were not accepted. I believe it was gender. Because I had a male counterpart in Kentucky…the people that I worked with would go to the engineer in Kentucky instead of to me who was two offices down the hall.

Early in her career, Cindy applied for and was accepted into a government sponsored long-term training opportunity where she received a graduate degree in environmental engineering. In reference to that professional development program she added, "Prior to this whole government funding and budget breakdown, there were wonderful opportunities for people to go back for long term training, but I haven't seen that in quite a few years in the government." When asked if she could relate a mentoring experience, she had this to say, "No, I really can't. Pretty much throughout my career I felt I was out there on my own and trying to develop myself, figure it out for myself."

Cindy perceives the field and culture of engineering as being "very much white male dominated." When questioned about why women and minorities do not seem to be increasing their participation in engineering and why the culture has remained static, she alluded to the chicken and the egg premise and said, "I think because the field is male dominated that women do not get the same opportunities as men." She also offers that engineering is "very demanding" and "not family friendly" as reasons for low female participation. However, this study has uncovered conflicting views about the supposed un-flexible culture in engineering workplaces. This topic will be discussed more thoroughly in the analysis of women's choice of work environments.

In conclusion, as we can see the size and the scope of the organization is seen to influence the extent to which the organization is concerned with or attentive to specific diversity

issues. When examining other factors that contribute to fostering an inclusive cultural climate such as professional development and mentoring, there is less evidence of support in either organizational context. Additionally, attention to mentoring relationships seems to be severely lacking and the informal nature raises questions of access and availability. The next section, in part, explores how some of the women exerted their power and agency through resistance strategies by employing their talents in organizations that were more aligned with their personal needs.

Choosing Employment in More Family-Friendly Flexible Organizations

Regardless of their company's size or scope, most of the women indicated that the organizations in which they are currently working are quite family-friendly, and allow for some work flexibility. In fact, some of the women contrasted this with their past experiences. Thus it seems that most of them made a choice to specifically work in such organizations. This may be read in contrast to the common assumption about the reason for the lack of women in engineering is that it is a demanding profession that does not allow for women to fulfill their familial responsibilities; all of the women who were interviewed, with exception of Margie who co-owns her own company, had positive experiences to relate about the flexibility and support of family in their current engineering work environment. Additionally, the results of the survey on the issues of flexibility and work/family balance support the qualitative data where the overwhelming majority responded favorably. This may be due to the fact that some of these women have made a conscious choice to work in such companies and that these choices are available due to the changing social roles of men and women.

The Flexibility in Family Friendly Companies

When questioned about how their organization facilitates or inhibits their family responsibilities, most of the women said they were satisfied and indicated that their schedules were flexible and their supervisors supported their family responsibilities. In other words, they indicated that they did not feel as if they were sacrificing in their personal lives to be successful engineers. Kara indicated that her current work environment is very supportive of her family responsibilities.

> I have five kids – my boss knows that I have five kids and the second oldest had to have an MRI yesterday. I would never have thought not to go, if the kids need something he [current supervisor] is very supportive. Also, I ride the bus downtown every once in a while and he sent me home in a taxi when I needed to get home quickly saying, 'Don't worry about it, we'll pay for it.' When it comes to the kids, my boss understands.

Similarly, Nina indicated her organization was very supportive of employees in regard to family needs and said:

> That was actually a good experience with my company. You had bereavement leave, sick time and – as far as the company policy stuff there were ways for you to go on leave as far as to take care of family members and to see to something. And the hours were pretty flexible, most of it is electronic timesheet based – sort of an honor system. You can leave during the middle of the day if you had an appointment and you don't have to check out with anyone. You just log your hours and log your sick time or your away time and make sure that you are putting in 40 hours a week, minimum a week, regardless if you do it on Saturday or Thursday night or Friday morning. And that was always very good and

managers were – the two, three managers that I had - were always understanding when it came to family issues and stuff like that. I didn't have any problems with that.

Also, Carol had a very interesting perspective and indicated she has seen a change in engineering organizations' change of perspective in regards to supporting family needs. She attributed this change to shifting social roles and offered:

> What's interesting is that a lot of the time, most of the men are fathers and have families. It is true at this job as well; the bulk of the men are married with children. And increasingly, it is clear that as men figure out how to take more responsibility for their own family work, there is a lot more latitude for women to not be pressured into neglecting theirs. That is what I find really interesting. Now you do have some men who basically just hand over everything to their wives to handle, but increasingly - there are a couple of single fathers at my current job for whom it is an issue to be able to take off and take care of family matters and have the flexibility. They live close to the office so they have the flexibility of making up time when they have the time. So far I haven't heard any of the women complain about not being able to take care of their family obligations.

Glenda is the only female engineer in her company. She also alluded to the change in gender roles as well indicating that her current employer is supportive of making time for a healthy family life. She reported:

> That is one thing that my current employer does very well. He offers a flexible schedule. And he has also verbally said that he encourages you to take vacation and he is very understanding about family issues. And we've had occasions where our kids have come into work. We don't do it very often, but there have been occasions where a couple of us will bring our kids in, like for half days over Christmas or something like that when the

> kids are off school and there isn't a baby sitter. Even my boss's wife has dropped the kids off for like an hour while she went to do something.

Deb had a similar observation. When asked about how her company inhibits or facilitates her family responsibilities she said:

> My job does not inhibit my family responsibilities at all because they have a flexible work arrangement. People can request to work at home. If people need to be out to take their kids to the doctor, a sick child, if they can't work at home, they can use another number to apply it to – as long as it doesn't happen too often. They are very flexible.

Likewise, Cindy indicated her current agency is family friendly saying, "…for the most part, they accommodate my family needs. I can work from home on an as needed basis."

Jane, a widow with a 10 year-old daughter, expressed the importance of a flexible work arrangement. She felt she was forced out of her previous job (where she had worked for over ten years) by an inflexible work schedule that was imposed when there was a change of supervision. She is very satisfied in her current work environment and laughed when she said, "…the day I left [previous employer] I had no intention of ever being an engineer again." The firm where she currently works created a position that met her needs by providing flexibility in the form of a part-time schedule with benefits and the ability to work at home as needed. She spoke enthusiastically when she said:

> [Current company] were so shocked because I had left [previous employment] and they wanted to talk to me – wanted to know why I kind of dropped off the face of the earth – as they said. After talking to them, they really offered me a nice position that was part-time and that's exactly what I was looking for. The arrangement that they made for me, it's a great arrangement I work 32 hours a week – that's four 8 hour days. I'm typically off on

> Fridays unless there is something that they need me to do extra, they know that I'll work on it at home on Fridays and be paid for it. My vacation is accrued based on a 40-hour week, all my benefits are based on me working 40 hours. I get three weeks of vacation, two weeks of personal days and the office is closed between Christmas and New Year's. They are a very nice company.

Margie's situation is somewhat unique in that she and her husband co-own a small consulting firm. Of owning your own business she commented:

> For years, I would work until 9 or 10 o'clock. Even after I had a baby, I would still be working 9 -10-12 hours a day. It's demanding, it's demanding owning your own business. It all comes back on you. You have to get it done so. I've just learned to delegate more and not take on as much and find people to help me out with the everyday stuff.

Dissatisfaction with Family Flexibility in Prior Companies

To be sure, there are examples where engineering organizations are perceived as less than supportive of employees' personal needs. Many of the women contrasted their current satisfaction with examples of previous work environments that they felt were not responsive to their needs. Some of the women felt they experienced negative consequences for requesting time-off or part-time work, in order to meet their family responsibilities, in their previous work experiences. Jane experienced perhaps the most dramatic dichotomy of an inflexible and flexible work environment. Jane's experience in her previous place of employment is an example that not all engineering environments are flexible in this regard. When Jane spoke of her previous employer she said:

> The manager that had hired me allowed me to work at home one day a week and allowed me to go part-time after my husband died. Then a new manager came in, a different

> woman, who was a communications major, and said that after working – I've been doing this since I was 19 – after working close to 30 years in the industry that I had to prove myself worthy of working at home. Then my part-time status was revoked and she and a female director told me that there are other people in the company that are in the same situation and they don't require any special treatment. And the director said, 'For example, both my husband and I work here and he travels so I'm a single parent.' And I just couldn't see the correlation between being a widow and having a husband that travels. After some thought and trying to make things work out, I decided it wasn't in my best interest or in the best interest of my daughter to continue working there.

Similarly, Glenda, who described her commitment to her family thusly, "I'm very family oriented, my main thing is I love my children" and related a negative experience with a previous employer saying:

> So I worked for him for four years and after two years, I got pregnant with my first child. And I was really torn; I wanted to be a stay at home Mom, but we couldn't afford it. I asked to work a reduced work schedule 30 hours a week, four days 30 hours a week, which is unheard of in the engineering community. When I first approached my boss about it he was like, 'What, you want to work four 10 hour days?' And I was like, 'No, I was thinking four, 8 hour days.' He was surprised and I remember him saying, 'Well, if that's what you feel you can work, then I guess that's OK.' And I thought he was OK with it. But soon after that, I just felt like; he hired someone else, a technician and he started giving the technician the work and not me and there was some things that he kind of gave me the brush-off, I felt. There was some community event, like a chamber of commerce dinner and he invited – there was three of us engineers two males and me – and he invited

> the other two engineers and their wives and he didn't invite me. And there was actually an extra ticket that went to waste. I really felt slighted and that was just one example of many. I thought he was pushing me out the door.

Glenda concluded the interview by articulating what she and presumably many women experience as a professional consequence when stepping back from their careers to focus on family saying, "I've enjoyed my work while being flexible in raising my family, but it hasn't allowed me to climb the ladder, because you can't work 30 hours a week and climb the ladder. And that's been a trade-off that I've accepted."

When speaking of her previous position, Kara indicated, "My old boss was also pretty good at supporting my family needs," but added "…in my old company, I never saw a woman return from maternity leave. They would go on maternity leave and not come back."

Carol, who has no children and is single, mused about some of the underlying issues and offered:

> There is a lot of pressure to overwork in this industry; I guess that would be the way - in that way it would interfere if they [women] couldn't figure out how to be flexible about their time. There is a lot of pressure to overwork – work really long hours. I think that was one of the reasons a young woman quit; she wanted to get married and start a family and she had been working until 8 o'clock at night. She didn't want to work week-ends. One of the things I would do is if I had something to do during the week related to family, I would just simply pick up hours on the weekend. My days weren't so long, but I would be working six or seven days a week.

The previous discussion provides an empirical basis for the conclusion that flexible family friendly engineering work environments exist and that, in some cases, women seek employment

in companies that are attentive to their needs. It also appears that a change in the social roles of men and women, that is as men are increasingly responsible for a larger share of family responsibilities, more organization that are sensitive to a healthy work/family balance are available.

Engineering: Not Above Racial or Gender Prejudice

Recall from the discussion of the survey scales in Chapter Four that unsolicited written comments on the returned surveys (or in some cases from engineers who refused to complete the survey) most frequently criticized the need to investigate issues of diversity in engineering and seemed to suggest that engineering as a profession, which is of course populated by engineers, is not subject to racial or gender prejudice. Although most of the comments could be attributed to white male engineers, a number of female engineers commented in a similar vein. Frequently, these comments indicated an approach that was critical of affirmative action philosophy, especially any practice that involves preferential recruitment on the basis of race, gender, or ethnicity and they tended to deny that certain groups were privileged while others disadvantaged. In order to investigate this issue more deeply, the interviewees were asked to respond to the idea that engineering was not subject to prejudice and that engineers do not care about or notice a person's race or ethnicity and/or the notion that "all engineers care about is how good of an engineer you are." The interviewees' perceptions about this area were clearly divided along generational lines. Additionally, race did seem to play a role in a more acute awareness of the multiple sources of oppression. The two women of color focused on the lack of awareness within the engineering community of racial/cultural and gender bias, while the white women spoke more frequently of gender bias.

Women of Color Challenge Notion of Engineering as Unbiased

Perhaps because they are women engineers of color and their experiences relate an intersection with multiple sources of discrimination, Deb and Carol provided the most perceptive comments when discussing how their experiences did not reflect this (in their opinion) false assumption that engineering does not notice a person's race or gender when making hiring or promotional decisions. Carol, who had a keen insight into cultural change and the necessity of action versus rhetoric, summed the situation up by saying:

> It's very easy for them to say something like that if they don't have any diversity at all. There's no evidence that that is true. How I feel about it is it's very easy to say that [hiring and promotional decisions are not made on the basis of gender or race] while your office remains all white and male. The proof is in the pudding. If all of this were true, you would have substantially more people of color and women in your company and you would have made an effort to make sure that that happened. They don't quite understand – when they say they are "color-blind", I read blind-spot. They have blind-spots that they don't want to acknowledge. Most of the time, when we do design work and we're checking to see if something is working, yeah, we are supposed to be scientific and dispassionate, 'Oh I didn't quite calculate that correctly. I need to think about what I'm doing and why I'm doing it – whether there is any basis for it.' What's odd is that they won't apply the same rigor to their hiring practice.

From a slightly different perspective, Deb alluded to the privileged status of white male engineers when she said:

> That's not a true statement. <laugh> There are no glass ceilings for the white male engineer. They are able to move up the ladder. For people of different ethnic backgrounds and women, it is very difficult to get past that ceiling. It is still an all boys' network.

When asked whether she thought white male engineers were invisible to the privileged status they held, she responded:

> Correct. The survey that we just finished doing for diversity and inclusion - I had a group that said, 'Do you really feel that there is a diversity and inclusion problem here at [current place of employment]?' And if you look at the make-up of the company upper management, there is a diversity and inclusion problem. The black lady that was there is no longer there. People that they promote are all white females and I think…pause…I think that's how they view it.

Notice that Deb also indicated that white women seem to be favored (over men of color and women of color) in promotional decisions. While she perceived female promotions in a positive light and was glad to see visible evidence of women in upper management, Deb was also aware of upper management's obliviousness to the continuing racial/ethnic inequality.

White Women Focus More on Engineering as Gendered

White women in this study tended to gloss over the question of racial prejudice in engineering to the issues of gender. For example, Jane alluded to the concept of the invisible white privilege, albeit somewhat cynically when she said, "That the people that don't want to discuss the lack of diversity in an engineering workplace, sometimes they [men or women] are the ones that benefit the most from the lack of diversity," she then when on to focus on women

and leadership issues. Speaking here of her experiences with female management that she believed to be promoted for reasons other than ability, Jane mused:

> My first response would be that I worked for someone who I considered to be the token woman director and I guess if you questioned her ability or questioned if she got promoted due to her merits, to her that would be opening a can of worms.

Jane went on to clarify her perception of the claims that engineering is not subject to prejudice and returned to it in more general terms saying:

> I think that a lot of men might feel that by saying or by acknowledging that some discrimination takes place are admitting that they may not be the best person for the job they have, so they kind of choose not to see it. They have no choice but to ignore it. That's something they don't want to think about publically and certainly not something they want to dwell on personally.

Cindy was careful to qualify her remarks as a white woman who has limited geographical experience in the engineering field. While Cindy's comments demonstrate her understanding of multiple sources of oppression, she focused primarily on her past experiences with gender discrimination saying:

> I think that statement is living in a dream world. I have not found that in my experience in working, but my entire career has been in Western Pennsylvania. And there could be more progressive areas out there where companies are more family friendly and they don't look at race or sex. Gosh, I've known female engineers that have lost their jobs when they become pregnant. Personally, when I was on maternity leave, I didn't get a bonus that year, because I was on maternity leave. But I'm thinking, wow, how about the guy that had knee surgery or back surgery that was not working and on recuperation too. Yes, they

> got bonuses. I think women - probably if you were talking to a minority male, he may say that minorities have it harder and that may be his experience.

Cindy's comments disclosed a subtle but important division in female engineers' perceptions based on age. Cindy has worked in engineering over 20 years and is in the 51-60 age group. As with most women of her generation in traditional male occupations, she likely experienced much more overt sexism in the early stages of her career. She expressed this thusly:

> And then I believe there are others who are prejudice. I've been told I don't want a damn female working for me - straight out. That was the response that I got when I was searching for a job and I wasn't hired and I contacted the interviewer to find out why. That was his reason. Like I said, I'm very cynical at this stage of my career <laugh>. Because I have experienced a lot of prejudice, a lot of having to prove myself over and over again. And when I was young in my career, I gladly proved myself and I said, 'OK, now this time is going to be the time when they finally recognize my ability' and sometimes it took a long time, sometimes it never happened at all.

When comparing the comments from the women who were older than 40 and those 40 years and younger, a distinct difference in perceptions was evident. The women who were 40 years or younger tended to agree with the statement that engineering, in general, was not affected by racial and gender prejudice. Since all of the women in this age group were white, their comments spoke specifically to what they perceived as the current lack of gender bias, with the exception of Kara who related her negative experiences with the "glass ceiling." Additionally some comments specifically addressed the previous generation of women in engineering and the likely overt discrimination that their older counterparts experienced.

Younger Women Perceive Less Gender or Race Workplace Prejudice

The four white female engineers in the 31-40 age bracket who were interviewed did voice some agreement that in their experiences, engineering does not suffer from racial and gender prejudice, at least not in entry level positions. Many of them also expressed that they have never personally felt unwelcomed or discriminated against as women in engineering work spaces.

Glenda, who attributed her lack of career progress to management or "climbing the ladder" because of her personal decision in requesting a part-time schedule to raise her family said:

> I think there is some truth to it [engineering is free of prejudice]. Like I said, there isn't some seeking out specifically of diversity, but if you can do the job, you can get respect from your colleagues and everybody. It only takes one person to prove or to change someone's mind. Like the example with my boss hiring the first female draftsman – now he hires females or males without any problem. All engineers care about is how good of an engineer you are – I would say that's true.

In Kara's experience, the field of engineering has made strides in changing the climate and culture in lower level positions. She seemed to support the basic premise saying, "In the mass ranks of engineering that [engineering is not prejudice] is fairly true. As long as you can do your job and do it well." However, she felt that when you wanted to move up the ranks to manager, director or supervisor positions, the assumption that everyone had a fair chance was not reflective of reality and she noted:

> However, I've seen that when you want to be an engineering manager, director or supervisor, that totally comes off. That is one of the reasons why I left my old company. Ten manager spots opened up last year and I interviewed for at least a couple of them.

> Some of them were not even posted, they didn't even interview; they just appointed people. But all ten spots went to ten white males. I was number two for one of the jobs and they admitted during my exit interview that I should have gotten the job over someone else, but he was a white male with five more years of experience, but it wasn't the correct experience; I was more qualified. And there is still a big – I mean the females really need - like it has to be – you have to be so overwhelmingly outstanding to get in over a male. I can even give you an example of where a director in my old company hired his high school best friend and college roommate to work for him over others that were more qualified. Yes – old boys' network, when you get into the management ranks, absolutely. Very problematic.

Notice that Kara did refer to what she perceived as a gender bias, albeit in connection to promotion, when she said, [Women] have to be so overwhelmingly outstanding to get in over a male." This gender bias will be explored in the next section on gendered assumptions.

While the remaining two women age 40 and under supported the premise that engineering is not prejudiced and indicated that they personally had not felt discriminated against because of their gender, they also talked about what they perceived as a generational shift in engineering attitudes towards women in acknowledging that women in the previous generation did experience discrimination.

When asked about her feelings about engineering and engineers lacking prejudice Margie stated, "I would agree with that." Margie then approached the idea of a female generational divide when she spoke about an experience she had at one of her previous places of employment saying:

> I remember in my first job, there was another female engineer who was a couple of years older than me and she just completely ignored me. I never got anything from her. Yeah, it almost felt like, I felt some sort of jealousy from her or some competitiveness. She wasn't very friendly.

She also spoke of her father's experiences of sexual discrimination in engineering offices, saying, "And he would tell me stories - I went into engineering in the early 90's - he would tell me stories about what he observed as a lot of sexism in the office." Despite this, her father had highly encouraged her to enter the profession. When asked about the difference in her and her father's experiences surrounding women engineers at work she said:

> You know, [those were] older male engineers just really being overtly rude and unwelcoming of females entering the profession. But I think that is definitely going to be on the, probably back then it was the 30 and up or the 40 and up, older engineers. But I never felt, at least in the large companies I worked for, any issues about me being a female. I mean no discrimination or not being wanted in the workforce.

Reviewing Margie's implication that older male engineers were primarily responsible for the sexual harassment, it seems likely, particularly considering 20% of the engineering work force is age 61 or older, that many of those older white male engineers are now in the upper management tier and influential in promotional decisions.

Similarly, when Nina responded to the question about engineering being oblivious to a person's gender or race she said, "I would agree with that" and related her experiences with the current hiring environment in engineering saying:

> I don't think that I've ever come across a preference or lack of preference for somebody based on their ethnicity or their gender. And that might just be because we sort of

> interview as a pool and we shuffle the person around and talk to them and if they have a good command of the English language and they seem to know what they are talking about in regards to their credentials…I haven't run into anything personally.

However, while Nina indicated that she never felt discriminated against because of her gender, she acknowledged that others have had different experience and also attributed it to generational issue saying:

> I don't feel that I was ever – anytime that I felt like someone was not respecting me, I saw them not respecting people pretty much across the board whether they were beneath them or equivalent in standing. It wasn't because I was a girl or anything like that. I didn't have any experiences like that. I've heard that people have, but I'm generally fairly outspoken, so I don't let guys push me around. I've definitely run into women in the field who have had difficulties and usually they tend to be in the generation previous to me and they sort of already paved the way and are still kind of angry about it, but I don't think I experienced anything myself.

Nina again referenced the generational difference in women's experiences when talking about mentoring. She explained her views thusly:

> You know, right now, I'd almost be inclined to say it's better to have a male mentor. Only because of a little bit of the psychological baggage that the older women in the field still seem to carry. There are women that I worked for who were still, you know, 'fighting the good fight.' And were, well they were looking for things where they thought they were getting short-handed on stuff. Because at one point they were [discriminated against], and it was very scarring for them. But I think they have developed a very adversarial

relationship with men in the field because of it. And I think that is something to be cognizant of, but it's not necessarily something to learn when you are in the workforce.

The next section investigates gendered assumptions, these taken for granted suppositions about the nature of engineering and/or engineers. The women who were interviewed frequently talked about perceived differences in ability and behavior of male and female engineers.

Dealing with/Deconstructing Gendered Assumptions in Self and Others

The fact that these women experienced engineering as not immune to racial or gender prejudice meant that they also had to deal with and deconstruct gendered assumptions, not only in others but also to some degrees in themselves. The supposition that male engineers are assumed to be knowledgeable and competent while their female counterparts have to prove their abilities, sometimes over and over again, was a common topic in the interviews. Half of the women interviewed talked extensively about the phenomena of supervisors, colleagues, clients and the public automatically assuming that male engineers are qualified while female engineers are required to prove their abilities by demonstrating their knowledge and competence. The common perception is that as women engineers, they are held to a different standard than their male counterparts. A related issue, that masculine traits are valued in engineering while feminine traits are a basis for questioning abilities, was also investigated, as well as issues about their own perceptions and expectations. In essence, these women discussed the issue of dealing with/deconstructing gendered assumptions in one or more of three primary ways: that female engineers bear the burden of proof of competence; women of color have different experiences and are perceived differently than their white counterparts; and gendered attributes of engineers.

The next section focuses on the phenomena of women engineers having to prove their competence as women and engineers in an attempt to constantly battling the assumption that their male counterparts are automatically more qualified.

Female Engineers Bear the Burden of Proof

Bearing the burden of proof refers to women engineers' experiences with having to demonstrate or prove their abilities before they are accepted as competent engineers. This contrasts with what they perceive as their male counterparts' automatic acceptance as capable engineers. Four of the women specifically discussed experiences where they felt that based on their gender, their abilities as engineers were doubted and to gain acceptance they needed to demonstrate their competence.

Carol approached the necessity of proving her abilities quite philosophically. She was very matter of fact when she said:

> What happens a lot when you are new, they want to test you. And they test you over and over again. The second job I had, this guy would come over and test me on something random every once in a while. And this can go on for weeks where you can expect that the way you are approached is 'Let me see if she knows this.' And once in a while, after I had produced a good design job or several design jobs, then I find the attitude shifts. Yeah, there are still going to be some guys who hardly ever talk to me – and that is true in this particular job – they can barely look at me, barely talk to me and they can barely nod at me in the morning. And then there are a core group of guys who said, 'Let's see what she can do.' They would often make comments that indicated they didn't think I knew what I was talking about. That rolls off my back more than it did 10 years ago, because I do know what I'm doing and I know that I know what I'm doing. I have

> learned how to move that along myself. When I hear a particular tone of voice or question coming from a guy, I don't dismiss it or get pissed off about it as much. A lot of guys won't ask what they really want to know so I will figure out how to address what they won't even ask openly – and that's a pain in the ass. Over time – it does take time – [to] get to a point where I stop getting that particular tone of voice. That's pretty condescending, the 'Gee do you think you know how to do this' kind of attitude. Never mind that I have professional engineer license, I've been at it for ten years, and I'm LEED [Leadership in Energy and Environmental Design] certified. No matter what I've done – it doesn't matter until you actually show them. They want to see.

Cindy expanded on the concept that unlike their male counterparts, women engineers were not adjudicated for their qualifications. Speaking here of the professional engineer license, which is nationally recognized standard in engineering, and graduate training she said:

> All of the female engineers in the Pittsburgh district had their professional registration. Many of them have Master's degrees and yet, when you look across the board, the number of promotions to supervisor…were male engineers without professional registration and without Master's degrees. And the female engineers had competed for those positions, but the male was selected. It seemed to be an excuse [the lack of PE status and/or graduate degree] when they didn't want to put somebody in a position. For example, if a female applied, they would say, 'Oh you don't have your Master's degree.' But then you look at a similar position where a man was in there without a Master's or a PE and that wasn't an excuse.

She continued speaking here of her past encounters with a general distrust of her abilities as a female engineer saying:

> I found that every engineering decision I made was questioned. And in both positions, I was hired as the engineer. In fact in [Agency B], I was the only engineer in the group. The rest of them were project managers. So I was supposed to be the engineering expert, but a lot of the designs that I came up with, a lot of the recommendations I made on…projects other than my own were not accepted – kind of disregarded. I found the same with the [Agency C]. It was – I was told I don't understand construction, I didn't know this, there was a lot I didn't know about [Agency C]. I would say I worked with six project managers…two of them kind of did come to see that I was capable and even valuable in giving an expert engineering design. The other four, no.

Like Cindy, Margie, who co-owns a regional consulting business, was philosophical about proving her and by association he company's abilities. She viewed it as a process in changing ingrained attitudes and celebrated her successes by saying:

> Yeah, we've probably done that [had to prove/demonstrate that a company owned and operated by a female engineer was competent and knowledgeable] several times with, well, being in Lancaster County, all of the contractors and the agricultural contractors that we work with are, you know, all male. It was probably difficult for them, at first, to get used to working with a female engineer and to be told – they used to build hog barns or manure storages one way - and it was difficult for them to hear that they had to increase the steel or put in more control joints or change the way that they were doing their construction. Here I am, a female engineer, coming in and telling them they have to change the way they have been doing stuff for the last ten years. But I think that they finally, I earned their respect, helped them out of a lot of situations. Helped them, usually

> getting permits approved for their projects, and now we have really good relationship with all the agricultural builders.

This example demonstrates that after an initial reluctance on the part of her male clients to trust the abilities of a female engineer, she and her company proved their competence to their male clients and gained acceptance and respect.

Glenda related a number of experiences where she felt her abilities as an engineer were questioned. Of her colleagues she said:

> When I start somewhere, at an engineering company, maybe I get a few second glances like – 'Oh I wonder who she is?' Maybe it's my imagination, but I feel like I get the once-over or whatever. I think you do feel like you have to prove yourself.

Interestingly, Glenda felt she experienced much more doubt of her abilities by clients and the public than by her colleagues and superiors. She discussed several instances saying:

> One time I was at a public meeting where…I was sitting in the audience and they asked for the engineer responsible for the plan to stand up and talk and I stood and there was a woman sitting next to me and she looked at me and said 'Huh, I didn't expect it to be you!' It was like 'OK, I don't know what that means'. But I also had one client that really disrespected me. He came in and he shook my supervisor's hand during the introduction and then he turned and he held out his hand to shake my hand, but he didn't even look at me. He shook my hand but continued to look at my supervisor and I was very offended by that because he wouldn't even give me the time of day. What I've noticed is that people tend to give male engineers the benefit of the doubt. They assume that they know. I went to DEP for a meeting with a male engineer who was younger than me, but then again, I don't look my age. He had a mechanical engineering background,

> and we were specifically talking about storm water engineering which he didn't have a background in and I was a PE and he didn't even have his EIT [Engineer in Training], I don't think. He was only a couple years out of college and didn't know what he was talking about and the DEP person talked to him the entire meeting. The DEP person didn't address me at all and I was the one – when we got back to the office, he [the inexperienced male engineer] was asking me, 'Well, what are we going to do?' And I had to explain to him what we were going to do. It's like if you have a female and a male engineer walk in, they automatically think the male knows more.

Although she didn't identify it as such, Glenda also alluded to internalized oppression when she wondered about her own prejudice, admitting:

> We had a couple of females, one particular girl that we hired, she was an engineer. And I found myself thinking 'Hmm I wonder how much she knows?' And I caught myself thinking, 'Am I doing the same thing that I feel like people are doing to me?' And I was embarrassed that I noticed that about myself.

These women perceived that their abilities as engineers were questioned because they were women and that as women engineers they were required to prove that they were competent engineers. They felt that male engineers did not experience the same disbelief and were perceived as competent engineers because they were men. Their experiences also empirically support the STEM literature that reports women feel the need to prove their competence in STEM careers (Benson, 1998 Trauth & Howcraft, 2006).

Women of Color: Perceptions Differ

While the experiences and perceptions of the women of color were similar in some respects to the white women, they also had some different expectations and experiences to deal

with in the workplace. Carol specifically discussed how her experiences as a female engineer of color differ from how she observed white female engineers being treated. Some of these appeared to relate to the fact that colleagues don't seem to have experience relating to women of color and consequently ignore her presence or treat her as if she is invisible. Recall Carol's experience in her current position where she said that some of her male colleagues, "can barely look at me, barely talk to me and they can barely nod at me in the morning." When asked whether she attributed this disregarding behavior to race or gender or just being a new employee, she said:

> What I'm usually faced with is that most white men do not know a lot of black women. And they only have an idea of who, I guess, they see on TV, who they see in grocery stores, behind the counter, who they see cleaning up the office. There is a black couple that cleans the offices where I work at now. So my experience has been that the bulk of the white men I work with don't have friendships or any kind of relationship with women of color in general and black women specifically. So I would say it's more that I'm black and female than just female. Because I hear white women talk about different kinds of issues than mine. They'll [male engineers] treat me like I'm invisible – just invisible. They [white women] will get treated like they are stupid. They are not invisible at least and white men know how to talk to white women but most of the stuff I get is that they have no idea how to approach me.
>
> Let me tell you what happened every time we lost a [white] woman at my first job. As soon as they were out of the room or out of the office, I would have to listen to them [male engineers] just rake her over the coals. With reckless abandon they would criticize everything that woman did the whole time she was there; 'she was really stupid, she

> shouldn't be hired anywhere else.' It was massive. And I'm not just talking about the rank and file, I'm talking about partners who would allow this behavior to go on. I watched a woman plumbing engineer go away for her wedding. They [male engineers] spent the two weeks she was on her honeymoon complaining about her work and never approached her about it. When I talked to her later, she never got any criticism in her reviews. They never said, 'Oh, we need you to clean this up.' They just vilified her whenever she wasn't around. And this was a pattern they had. I never heard any partner interrupt it at all. Sometimes, I have this fantasy where the guys who have daughters…I think they forget that the rest of us are daughters also and we also have fathers who really think the world of us. They just can't make the connection that how they treat women in the workplace isn't the way you treat the women in your homes or how you would want you daughter or wife treated.

While the other female engineer of color, Deb, never specifically referred to how her experiences may have differed from her white female counterparts, she did imply that people of color are not "seen" or visible. When asked directly about any barriers or exclusionary practices she may have experienced as a female African American engineer she said:

> I have to say I've never gone through specifically exclusionary activities that people have had towards me. Maybe they have had some, but I've always…I'm a direct person, so if I see an issue I'll go to the person and I would say something. So I've always been a strong willed person that I've been able to overcome anything that has come in my way.

When speaking of people of color in engineering in general, she did mention that there is less awareness or visibility for people of color.

> Is diversity just women being promoted or is it also looking at people of different backgrounds. …although they [management] say diversity is all inclusive…they may look at one category not the entire spectrum. They don't look at the entire picture. They don't look at the management layout and see Wow! There is no one of Middle Eastern background, there is no one here of African American, Hispanic or Latino. They don't see [that there is no evidence of people of color in management]. I'm not sure what they see.

Gendered Expectations and Attributes of Engineers

Although not as commonly mentioned in the interviews as the other themes, the perceived behavioral differences, attributes, and competencies between female engineers and their male counterparts is important to note partly because it may inform the previous issue of women bearing the burden of proving themselves as competent engineers, and was brought up by some of the participants in response to questions about their learning process and why they choose engineering as a career. On the one hand, engineering competencies are paradigmatically defined by complex masculine standards, and on the other hand, competencies most often valued and encouraged in female engineers focus on one skill, academic ability. In some cases, the participants implicated the academic engineering culture in creating these competing and gendered concepts of desirable attributes of engineers.

Glenda, for example, discussed what she perceived as fundamental behavior differences between her and her male colleagues. She identified an ego-driven culture of superiority and competition, which she attributed to the academic engineering environment by saying:

> I think that goes back to college and is a whole other engineering subculture, that testing and competition. I've put up with it, but yeah, there is a lot of that. I think it is a part of

> the culture and it goes back to the days when you are in college and they weed you out. I remember when I was in college, I took a creative writing class, and I would go into that class and everybody was sharing their ideas and people were getting up and sharing their stories and it was a completely different classroom culture. Then, I would go back to my engineering classes and everybody is hiding their papers. <laugh> I don't know where that comes from.

Glenda expanded on the culture of competitiveness and testing, similar to a game, where male engineers tried to uncover weaknesses in each other. She related an incident where her ability was discounted because she failed to play along saying:

> I came in and [they] both males, were talking about a specific job…I walked into the room and they were like, 'Well what would you do in this situation?' And they had been talking about it for like a half hour, what to do with this water treatment plant, and I said 'Well I don't know what the problem is so…I don't know.' He looked up at me and said 'I figured.' And it's just, it always seems like there is something.

Carol also talked about the bravado and superiority that some male engineers display. She spoke in general of male engineer behavior when saying, "See, guys will talk as if they know what they are talking about <laugh> and they will sound very convincing, because that is what they are trained to do – to sound like you know what you're talking about." She continued to explain what she views as the masculine model of an engineer saying, "The typical [male] engineer that I run into believes, very sincerely, that he's smarter than everybody else in the room and everyone else's input really isn't required."

Carol also hypothesized that few women are in upper management in engineering due to differing leadership styles, explaining:

> I have low expectations of being thought of as a leader in this field, because so many of the definitions of manager and of project manager are male centered and male identified. It is interesting in the way it takes women a lot longer to be moved in that direction, because our styles don't look like their leadership. The way we do things doesn't look like leadership. We have different styles and we [women] aren't validated by it. So we are perceived as not being effective. They [men] only know of their own way of doing things, but I think most of us aren't convinced that that is the best way to do it. You want to engender loyalty because people understand what your goals are, you respect people, you validate people, tell them when they are doing really well, be honest with them, with any struggle they have. Don't openly humiliate them or target them with humiliation of any kind. And they call that a female way of doing things, except that I think it has more long-term effectiveness.

Along with these gendered behaviors, some of the women spoke of valued competencies in engineering and indicated that for women, attaining those competencies may be akin to shooting at a moving target. Many women are motivated or encouraged to go into engineering because of their superior math and science ability. There appeared to be an indication that these academic abilities are not necessarily as valued in engineering workplaces as the experiences that many of their male counterparts may have had while growing up such as working on cars, fixing engines and building things. When asked about why she became an engineer, Glenda expressed this paradox by saying:

> It was probably one of the worst reasons to go into engineering. I was good at math and science and my parents mentioned about you might want to consider - my father did electrical engineering. So there was some family background, but the thing is, he never

> took me to work and I never understood exactly what he did. And I didn't fix car engines and stuff like that. I was good in math and science and I decided to go into engineering because of that. I've read some posts on internet forums and stuff that a lot of male engineers don't like that about female engineers, that they have gone into engineering because they are good at math and science. They [male engineers] think, 'Well I fixed engines and I built things.' [They are] tinkers and that's the way engineers should be, and there probably is a little bit of truth in there.

When asked about what type of mentor is better to learn from, Nina mentioned the value of having "just a guy and – the sort of 'gear heads.' The nuts and bolts focus…If I was interested in taking something apart then that was cool [with them]." Nina's statement also speaks in general terms of engineering as a hands-on profession and the desirability of getting into the field and learning by doing. As Glenda indicated above, just because someone is good at math and science does not mean they will be good engineers.

While Cindy indicated her initial motivation for choosing engineer as a career was her math skills, she agreed with the importance of continuing to learn on the job.

> I was very good in math…[However], there is, especially in engineering, a lot of on the job training. When you are at university you learn the basics, but I don't think engineers, and I see this a lot in design engineers, they are not able to think on the spot. They are not intuitively able to adapt their knowledge and their training and their technical abilities to a field situation where you have to make a decision. Like, this footer is not right; or this hillside is sliding. We need to do this, this, this and this. They want to get their surveying equipment out, they want to go back and crunch calculations and I think that

> both of those make a good engineer. So I would say that a lot of it is on the job and out in the field.

Similarly, Jane also emphasized the importance of people entering engineering understanding that the academic preparation does not necessarily reflect the work environment saying:

> They somehow have to teach the younger people that what we do is really not exactly how you learn engineering in school; that things aren't straightforward and they are not black and white. There are a lot of grey areas in engineering and doing calculations. If you are say, sizing a pump or sizing a pipeline, one person may do it and get one answer. Someone else may do it and get something within 15%. There are a lot of assumptions to be made and educated guesses and that comes from experience.

Kara summed up what she perceived as an overall misconception between engineers' expectations of the job environment and what they learn in school. When asked how she learned to be a good engineer Kara emphasized the importance of hands-on work experience by saying:

> Hands-on. When I worked in operations I literally turned on valves and changed out pumps and all that sort of stuff, gloves-on, sweating every day. And then right after operations, I went into designing compressor stations and then I went out and built compressor station. That was my year in New Jersey. So I literally was on-site for a year; hands dirty, gloves dirty, sweating in the summer and freezing my butt off in the winter. You have got to get out and see it, you've got to get out and do it. And a lot of the young engineers I've seen, male or female, coming out of college right now - part of that millennium generation – they don't ever want to get out and do the hands-on. So it's

a big thing and they need to be forced. If you want to be a good engineer, you have got to go.

It appears as if engineering culture values masculine behaviors and mechanical abilities; the ability to put things together and take them apart, fix motors and engines, and build things, etc. Conversely most of the women indicated they choose or were encouraged to choose engineering because of superior math and science abilities and that learning engineering via hands-on experiences was not necessarily a component of their academic preparation. Thus, the skills that were valued in their academic experiences were not necessarily valued as much in their work. Although these differences are sometimes very nuanced and subtle and the women most often did not address the issue directly, there does appear to be differences in how men and women are socialized in engineering that may be worth investigating further.

Summary

This chapter presented the findings of the qualitative portion of this research study and in particular to research in-depth female engineers' perception of diversity and learning in their work environments. These findings suggest that organizational context plays a role in female engineers' perception of workplace diversity and indicate that larger organizations that are U.S. or internationally based with a global scope are more supportive of diversity. Additionally, the women's engineering experiences, bring into question a common engineering rhetoric that engineering worksites are not welcoming and do not support family obligations. The positionalities of age and race did seem to be a source of diverging experiences and there was evidence of interactions between these positionalites, particularly race and gender. When investigating the phenomena of engineering as immune to racial and gender prejudice, generational differences in the women's perspectives emerged, and not surprisingly the white

women spoke more about gender than race. Finally, the female engineers confirmed that their skills as engineers are commonly doubted and some indicated that for women, engineering competency seems to be a moving target. The commonly espoused criterion for women to enter engineering is superior math and science aptitude, but those skills may not be as valued or as relevant to the work environment (and their male colleagues) as their academic preparation suggests. These findings combined with the findings of the qualitative portion point to some research avenues worth investigating further. In Chapter Six, these research implications as well a more thorough integration of the quantitative and qualitative findings are presented.

CHAPTER SIX: DISCUSSION

The purpose of this research study was to investigate engineers' perceptions of diversity and the workplace learning environment surrounding diversity education efforts in engineering occupations. A mixed methodology was used to gain an overall understanding about engineers' perceptions as well as an in-depth understanding of the perceptions of women engineers, engineers who are women of color, women engineers who are age 40 and below, and women engineers whose general perceptions of the engineering cultural climate is not favorable.

One of the strengths of mixed methods research is that findings from the quantitative and qualitative sections can provide additional support or methodological triangulation (Lodico et al., 2006; O'Cathain, Murphy & Nicholl, 2007). Additionally, the plurality in findings can provide a more comprehensive picture of the research topic by combining a broad landscape approach with the ability to clarify or provide a deeper understanding of relevant information. To be sure, not all findings will have a connection and some findings that do not appear remarkable when examined through a mono-theoretical lens become enhanced when examined through a bifocal perspective. In the following discussions, it is important to remember that the quantitative findings did discover that although female engineers have positive perceptions of all the engineering cultural climate indices their perceptions are less favorable than their male counterparts and the demographic make-up of the survey sample while nearly equal in terms of men (55%) and women (45%) was overwhelmingly white (94%).

The first section in what follows will integrate, where appropriate and informative, findings from the quantitative and qualitative methods where they corroborate. Next, a discussion on how the findings of this study inform the current research base of diversity in engineering is presented in light of some of the conflicts or nuances made apparent through

examining the quantitative and qualitative data together. Finally, theoretical, research and practical implications of the current research are presented.

Corroboration of Mixed Methods Findings

In the current study there were areas where the quantitative findings were supported by the qualitative findings and the in-depth analysis of the plural findings informed the literature on women in engineering and provided new research avenues. Two areas where the integration of findings provided a better understanding of the issue are the apparent expanded presence of flexible/family friendly work environments and the reliance of on the job and mentored learning experiences for engineers' development.

Flexible/Family Friendly Work Environments

One of the most interesting findings was evidence of flexible and family friendly engineering work sites. As discussed previously, a main theme for women not entering into engineering or opting out of engineering careers is the lack of flexibility which led to the inability of female engineers to fulfill their family responsibilities (Frome, et al. 2006, Hult, et al. 2005; Litzler, et al., 2005). However, approximately 70% of the survey respondents agreed or strongly agreed that their company provides job flexibility in the form of working at home and compensatory time. Additionally, 80% responded favorably that they are satisfied with the balance between their work and personal responsibilities and 85% indicated they feel comfortable taking time off to deal with a family or personal issue. When investigating the issue deeper, the women who were interviewed seemed to confirm the notion that there are organizations that provide flexibility and are encouraging of a good work/family balance. All of the women, with the exception of Margie, who co-owns a company with her husband, indicated their current work environments are responsive to their family needs and provide flexible work

arrangements. However, recall from Chapter Five, that in many cases, these women had previously worked in engineering organizations that were not as family friendly and choose to seek employment in companies that were more supportive of a good work/family balance. It appears as if these women employed an effective resistance strategy and thwarted dominant culture by making a conscious choice to employ their talents in organizations that were more responsive to their needs.

It could be conjectured that, in part, more flexible engineering organizations are available due to the changing social roles for men and women (Galinsky, Auman & Bond, 2008). As Carol indicated, "And increasingly, it is clear that as men figure out how to take more responsibility for their own family work, there is a lot more latitude for women to not be pressured into neglecting theirs." With more women, wives and mothers, entering the workforce and more men finding themselves as single parents, men are likely to have increased family responsibilities. Thus as the traditional engineering workforce (white men) require work environments that allow them to meet their personal responsibilities, engineering culture change is occurring. However, there still seems to be an issue, primarily for women, who request reduced or part-time work schedules in the early years of motherhood. Glenda indicated that she was fully aware of the professional consequences in the form of lack of advancement for reducing her work hours to focus on her parenting role when she said, "I've enjoyed my work while being flexible in raising my family, but it hasn't allowed me to climb the ladder, because you can't work 30 hours a week and climb the ladder. And that's been a trade-off that I've accepted." Although it seems as if the culture is improving in accommodating women's family needs, the women who were interviewed indicated they were active agents in choosing those work environments and even then, flexible work schedules do not go so far as to allow women

(or men for that matter) time off to raise young children without professional consequence. Perhaps a reframing of the issue is in order. Research questions that investigate how women negotiate work environments and use their agency to seek employment that is more suited to their family role might contribute to practical advice and solutions for women. For example, what strategies do women employ to subvert the dominant system and what are the pressures (social and political) that exert culture change? What role does individual agency versus dominant power structures play in these changes? What are the characteristics of flexible family friendly engineering companies?

Workplace Learning: Primarily On the Job

As discussed in Chapter One and Two, learning is a broad subject that relates to a number of areas that are important in the current study. Although the survey addressed several areas of workplace learning, the focus of this discussion is on the prevalence of on the job learning which includes mentoring experiences. Chapter Five addressed mentoring in the context of attention to diversity and on the job learning in the context of gendered assumptions via academic preparation versus real world engineering. Obviously, these experiences are important in an engineer's ability to succeed and negotiate their work environment but problematic to analyze in terms of accessibility and value due to the serendipitous and unstructured nature. Additionally, considering workplace learning frequently serves the organization while issues of power and privilege remain invisible (Kell, et al., 2004; Kimmel, 2008; Sheid, 2001), a discussion of how women negotiate these opportunities and experiences can inform the research base and illuminate resistance strategies. How the women who were interviewed perceived learning via mentors and on the job experiences can bring insights as to the availability and function of this specialized and somewhat esoteric type of learning.

Eighty one percent of the survey respondents indicated that most of their learning is done on the job and slightly less, 72% indicate their company encourages learning through mentoring relationships. As discussed in Chapter Five, the women who were interviewed confirmed these findings as all of them indicated that on the job learning and mentoring is a big part of their development as engineers. Jane reinforced the prevalence of on the job learning in engineering saying, "My learning was on the job and it's done a lot of times." Similarly Cindy commented, "There is, especially in engineering, a lot of on the job training." Kara was very succinct when asked how she learned engineering saying, "On the job."

Although all of the women who were interviewed indicated on the job learning, including mentoring experiences was a big part of their development as engineers, they did not necessarily expand on how those experiences were structured in terms of availability and value. They did indicate that few of the companies where they worked had a formal mentoring program and although they sometimes found the experiences valuable in their development, mentoring was more often than not "hit or miss" (Carol). These learning experiences of the women engineers demonstrate that opportunities are not necessarily obvious and frequently depend on either the individual to seek out learning opportunities or the leadership of the company to provide these experiences. Carol explained the issues with on the job learning in term of accessibility and career progress when she indicated that if job experiences that promoted growth were not available, employees could become stuck doing rote and routine work. What may be perceived as an advantage to the company, in the long term, could be a disadvantage to an employees' career growth. Carol explained the danger of relying only on opportunities that companies offered saying:

> I came into engineering kind of knowing that the only way you are going to learn anything is by doing it and learning how to develop stamina in getting it wrong and doing it over and over and over again. [But] part of the way you can end up with a limited career path is – the way they think about it as a business manager is 'Who can I put where and how can I keep them there?' Especially if they are effective and they help [the company] make money. So it doesn't really matter whether you have aspirations in any other particular direction, if you are not seen as someone they want to develop anyway, they want you in a spot where you are predictable.

Thus the political aspect of workplace learning may serve to advantage the organization and the dominant culture through the availability of career advancing experiences. Because these experiences are primarily unstructured and not evaluated, those issues of power and privilege remain hidden (Barrett, et al., 2003; Johnson-Bailey & Cervero, 2004; Johnson-Bailey & Cervero, 2008). Additionally, the impact of self agency, individuals intentionally seeking valuable work experiences or mentors, is unclear. Since on the job learning and learning through mentorships appears to be a significant factor in engineers' development, and most of it is unstructured and serendipitous, it is an area that could benefit from more critical analysis that can make those invisible structures more evident.

Interpretation of Mixed Methods Findings

For the current study, the qualitative findings provide some clarification or explanation of inconsistent or contradictory quantitative findings in two particular areas. First, the survey findings indicated confusing and contradictory results regarding specific questions about diversity. Second, in a rejection of Hypothesis 16, which hypothesized that effective retention strategies would be the strongest predictor of employee engagement, the data showed that the

predictor with the strongest relationship was interpersonal climate. The interviewees were asked, as engaged employees, which index they considered most important. Their perceptions may provide a better understanding of the relationship between the diversity indices and employee engagement. The discussion of those findings is presented next.

Conflicting Concepts of Diversity

The overall survey results seem a bit confusing and contradictory in regard to diversity, learning about diversity, and the value organizations and leadership place on creating inclusive environments. For example, 59% of respondents indicated that they disagree or strongly disagree that all employees receive diversity training and 51% disagree or strongly disagree that their organization makes sure all employees have skill to work with diverse groups. Additionally, 43% of the overall sample indicated they did not perceive diverse employees at all levels of their organizations and 68% indicated their organizations did not use nontraditional networks such as social networks, minority organizations and/or trade publications when advertising for a vacancy. Given these results, it is not surprising that close to 40% responded in the negative that maintaining a diverse staff is important in fulfilling their company's mission and goals and/or value for diversity is a part of the mission statement. Yet, 65% agreed or strongly agreed that their company values learning about diversity and 75% indicate leaders are role models for valuing diversity. While the current theoretical and research literature on diversity is clear, in order for organizational cultural change to occur it has to have strong support and buy-in from the leaders at the top (Cox, 2001; Rasmussen, 2007; Resnick, 2009) what is unclear is, if there is a value for learning about diversity and leaders model that value, why is there a lack of diversity training and diversity goals documented and supported in mission statements? Analyzing the qualitative data for this issue may provide some clarification.

First, the term diversity is not well defined and has multiple meanings. One male survey respondent indicated, "Diversity is not a term understood by my age group (61+). I know of it because I took a course in 'racism and diversity.' You would have done better by first defining diversity or talk in terms of equal employment opportunity – those able to perform the work regardless of sex, race, sexual orientation, etc." Deb also questioned organizations' understanding of the term diversity saying, "I think companies have different definitions of diversity, although they say diversity is all inclusive…they may look at one category not the entire spectrum."

As indicated in Chapter Five, the white women who were interviewed focused much more on gender as a measure of diversity than race or ethnicity. Perhaps some of the contradictory survey results are due to the primarily white engineers having multiple meanings or a lack of understanding of what diversity meant in terms of answering the survey questions. These findings, as well as the discussions in Chapter Four and Five regarding the assumed lack of racial and gender prejudice in engineering, suggest that some white men and women have an incomplete understanding of the concept of diversity and may fail to see the link between intent, education, and action in increasing diversity in engineering. This incomplete picture of diversity seems to be compounded by the role of education and learning in engineering.

This study indicated that in engineering worksites the purpose of learning is conceptualized as a vehicle to gain technical skills. When the interviewees were asked about learning or professional development, they all referred to opportunities and resources that enhanced their technical base. Furthermore, even to enhance their employees' technical knowledge, many engineering companies are not overly supportive of formal education or training that places a financial burden on the company. Cultural competence appears not to be

understood or seen as something that can be enhanced or learned through education or training. As Carol indicated, “[They think] all you have to do is have good intentions and that makes it true.”

What conclusions can be drawn from the confusing survey data and the in-depth perceptions of women engineers? First, as discussed in Chapter Five, female engineers of color had a deeper understanding of action and practices play a role in diversifying organizations. Deb made a strategic decision to work at her current company based on their demonstrated commitment to diversity, in policy and action, and the visibility of both white women and women of color in management positions. She reinforced this by adding, “The first time I’ve had diversity and inclusion training was at my current company.” Similarly, Carol, who choose to work in her current organization because the leaders had previously worked in an organization well known for their policy and documentation of diversity, spoke of effort when she said, “If all of this were true, you would have substantially more people of color and women in your company and you would have made an effort to make sure that that happened.”

Second, some of the white women did make a stronger connection between intent and action and diverse organizations. These women contrasted experiences of workplace climates that were not supportive of diversity and demonstrated an understanding that among other things, an organization’s visible commitment to diversity in form of policy and education affected workplace culture. Cindy articulated her understanding by saying, “What I see now in the [current agency] is that there are written policies, there are trainings in diversity, gender in the workplace that the other two agencies say they have but the emphasis really is not there.” Kara emphasized the importance of management commitment when she made the choice to change companies by saying, “Yeah diversity and management. I went looking for management that

would actually lead…" Nina, who indicated she was satisfied with the multicultural environment of her work and had no complaints about her organization's commitment to diversity succinctly said, "…they have it as a policy 'We're diverse and we want to be diverse.'"

Finally engineering seems to suffer from, as Carol said, "a blindspot" and there does seem to be a lack of awareness that even in engineering, a profession that strongly identifies with objectivity, people have ingrained, socially constructed prejudice that affects their decision making (Kimmel, 2008; McIntosh, 1988). However, Jane touched on another issue, when she said, "That's something that they don't want to think about publically and certainly not something they want to dwell on personally." Hypothetically, a plausible explanation for this lack of awareness could be a combination of a traditional masculine culture, the resistance of the dominant group to yield power and the invisibility of privilege.

Hence, current research on diversity and multiculturalism indicates that without demonstrating the benefit of enhancing diversity, including the dominant group in the effort, and education that brings this prejudice to light, it is very difficult to effect organizational change. Beyond the issues of inequality and social justice, why would an organization pursue culture change to enhance diversity? The qualitative findings point to at least one recent business phenomena, the trend towards multinational corporations and globalization, that is driving the paradigm change from exclusive traditionally male and white organizations to organizations that embrace diversity for survival. Pressure, in the form of environmental change, can sometimes force educational effort, policy and action. For example, the comment from a male survey respondent reinforces this current economic and demographic pressure, "[I am] CEO & COB of an ESOP owned company. In this region of the company, most, if not all companies have to recruit from diversity as too few white American males are available in our discipline." This

pressure was also demonstrated in the discussion regarding organizations with an international scope; workforce demographics are influenced by the demographics of geographic locations and in turn influence the entire organizational diversity culture. Thus, in some locations, the sustainability of the organization is dependent on an integrated workforce. It seems as if engineering could benefit from a better theoretical and more thorough understanding of diversity. Additionally, in light of demographic influences and the reality of a diverse workforce, a long term view of the sustainability of engineering organizations could provide impetus for a move from traditional culture to a more inclusive environment. Next, a discussion of the quantitative and qualitative findings regarding the relationship between the diversity indices and employee engagement is presented.

Diversity Indices' Relationship with Employee Engagement

The quantitative findings identified five significant predictors of employee engagement. In order of their strength as a predictor, those indices are: interpersonal climate, leadership, retention, age, and recruitment. As discussed previously recruitment had a negative relationship with employee engagement, meaning that more positive views of recruitment may predict more negative views of employee engagement. It was hypothesized that, for some engineers, resistance to specialized treatment of groups, a rejection of affirmative action perspectives and resistance of the dominant group may account for this inverse relationship.

Although the interviewees' views of employee engagement did not necessarily impact on the qualitative findings in Chapter Four, they are important to discuss here as they inform and provide an understanding of the relationship between cultural climate factors and employee engagement. The women who were interviewed had differing views of which index they considered the most important to their job satisfaction. In an interesting analysis of discourse,

most of the women qualified their remarks in juxtaposition to negative work experiences. Two of the interviewees, and the only women in the 51-60 age group (no women in the 61 and older age group were interviewed), Carol and Cindy, agreed with the survey findings and listed interpersonal climate as the most important contributor to how engaged they felt as employees. Carol highlighted supportive work relationships and camaraderie saying, "I guess I would have to go with the interpersonal, because I guess what I was most unhappy with in my other job, the one that I quit, was that I didn't feel part of a team of people."

On the other hand, Cindy, interpreted interpersonal climate to mean being valued and respected as an employee saying, "I think the most important one for me would be interpersonal climate. I guess as long as I feel that I'm valued as an employee…in my last two positions, I don't think I ever once got a thank you, good job." Cindy also touched upon the effect age may have on an employees' perspective when she added:

> The other three, the learning environment, the recruitment and the retention, not that they weren't important to me at one time, but I just think because I'm at an end of career – I'm within about 5-8 years of retirement…they have kind of taken a lesser important meaning for me. But I can see where a younger engineer, that would be very important.

While the women in the 31-40 age group had different views on which factor they considered the most important, they all three mentioned leadership as an important quality.

Kara indicated that along with the economy, leadership was an important factor in her job satisfaction and indicated what she didn't appreciate in leadership saying, "But don't micro-manage and don't come up with policies mid-stride then come and yell at people." Similarly, Glenda also identified leadership, but looked to management as a source of enthusiasm and

excitement for the profession. While Nina, indicated leadership was important, she was most critical of what she experienced as the lack of learning and growth opportunities when she said:

> The educational opportunities…what's been the most frustrating is the lack of a challenge…there doesn't seem to be enough challenging opportunities for people to push forward and think and learn. I feel like if you go into engineering you are someone who is at least minimally creative.

Both Margie and Deb indicated communication was the most important quality in their job satisfaction. Margie's remarks were also referenced to a negative experience in a prior work setting. Margie said: "I think a lot of conflict in those types of offices [large multi-departmental firms] is because of probably not good communication."

Similarly, Deb talked about the importance of communication in developing relationships between employees and departments when she said, "Networking, to see what other people are doing, to talk to other people. To see what opportunities are available."

Jane viewed the learning environment as the most important aspect of her job enjoyment indicating, "I think the learning. I like to be challenged and I like to feel that the work that I do is important and it is valuable. It's important for me to learn different things."

What conclusions can be drawn from this examination of the survey results combined with the qualitative findings about employee engagement? Clearly there is a good bit of variance in what individuals perceive as important to their job satisfaction. Although the survey results indicate that interpersonal climate is the best predictor of employee engagement, other aspects (leadership, retention, age) were also significant as positive predictors. An explanation of the difference in perceptions appears elusive. It makes common sense that people in different stages of their career would value different aspects of the cultural climate and have different

perceptions employee engagement. Indeed, the age of the individual does seems to have some influence as demonstrated by the significant predictor relationship between age and employee engagement and the similarity of responses for the women in the 51-60 age group who discussed interpersonal climate and those in the 31-40 age group for whom leadership was at least one of the areas they highlighted. However, when analyzing the women's comments, it appears as if the factor that was most important to them, was an area where they had been subjected to negative experiences. While no definitive conclusions can be made from this observation, it may well be worth investigating. Likely what causes employees to be engaged is a complicated interaction of individual psychological, social and structural factors that go far beyond the intent of this study. Little research based literature examining the relationship of employee engagement and organizational characteristics exits (Saks, 2006). Therefore, these results do add to the body of knowledge and research in this area and contribute to an understanding of organizational factors that may be significant in employee engagement.

Contributions to the Literature

This section discusses the ways in which the current study supports and informs the literature on organizational diversity, adult learning in the workplace and underrepresentation in engineering. The discussion begins with the implications for the literature on organizational diversity and ends with a discussion of how the findings impact the literature on underrepresentation in engineering.

Organizational Diversity

This study supported and contributed to the organizational diversity literature base. The current literature in organizational diversity often highlights a number of reasons why diversity efforts are frequently less than successful. These include: (a) lack of a complete understanding

or clear definition of diversity; (b)lack of critical theoretical grounding; (c) lack of evaluation; (d) lack of organizational commitment, (e) misunderstanding the type of learning involved (affective versus instrumental); and (f) a focus on minorities that alienated dominant groups (Cox, 2001; Rasmussen, 2007; Resnick, 2009). The current study indicated that a clear and common definition of diversity was problematic; even when a definition was articulated individuals tend to interpret the concept of diversity according to their own experiences. Of the engineering organizations that had an awareness of diversity, the approaches commonly lacked critical grounding and little evaluation. Most frequently an organization's commitment was demonstrated by a statement in the mission and goals. For example, a little over half of the survey responses indicated that diversity is important in fulfilling their company's mission statement and goals while 61% indicate that valuing diversity is part of the mission statement and supported by policy. Furthermore, 65% of respondents indicated that their company values learning about diversity but 59% disagreed or strongly disagreed that all employees receive diversity training. Clearly, an overall commitment to diversity in engineering organizations is weak. It seems as if the engineering community could benefit from a more thorough understanding of diversity principles. The following sections will focus on two areas that support and contribute the organizational diversity literature, the strong resistance of the dominant group and the effect of globalization in diversifying organization.

Inclusion of the dominant group. The current study highlighted the difficulty in successfully changing organizational culture to more inclusive environments and supports the diversity literature's call to include the privileged group in diversity efforts. Strong evidence exists that one of the reasons for the lack of diversity progress in engineering is resistance of the dominant group. As discussed in Chapters Four and Five, a dissident narrative of engineering as

above racial or gender prejudice, meaning that racial (or gender) bias does not exist in engineering, refutes the need to investigate diversity in engineering. Since the underrepresentation of women and people of color in STEM occupations is well documented (Gibbons, 2008; National Academy of Sciences, 2007) these perspectives seem to represent a denial of reality and indicate a misunderstanding of hiring and promotional practices specifically designed to widen the level of participation.

These perspectives ignore structural and social realities that advantage the dominant group and disadvantage others. They also highlight the importance of addressing the resistance of the privileged group in diversity efforts including a more thorough awareness of the invisibility of privilege. The literature on organizational diversity addresses this issue and encourages inclusion of the dominant group because, as demonstrated in the Chapter Five, this lack of perspective may create fear and resistance and diversity initiatives are often interpreted as "employment gains for women and racial-minority men at the expense of the traditional power group…" (Cox, 2001, p. 60). Incorporation of critical perspectives in organizational diversity efforts that address the concerns of the dominant group is one way to alleviate the resistance of the traditional group. These practices include making visible the invisibility of privilege and practices that advantage the dominant group as well as demonstrating the benefits of diversity for all groups.

The effect of globalization in diversifying organization. This study also contributes to the literature by identifying an emerging area of research, the effect of globalization in diversifying organization. Although the data is sparse, a connection was perceived and in light of the trend towards globalization and multinational corporations is worth pursuing. Many organizations have come to the realization that it is no longer realistic or economically

productive to maintain an organization with an all-white/all-male work force, particularly in a global market environment where many companies are internationally or multi-nationally owned with locations throughout the world (Askanasy, Hartel & Davis, 2002; Shriberg & Kumari, 2008). As discussed previously, the current research supports and informs an emerging perspective researching the effect of globalization and multinational corporations in creating diverse organizations. The qualitative findings in Chapter Five suggest that there was greater perceived attention to diversity by those working in larger organizations with a global scope. The influence that these global organizational contexts exhibited on learning and diversity included evidence of an official diversity policy, a demonstrated strength of commitment to the diversity policy in terms of company action and intention and evidence of diverse employees in the multiple locations throughout the world. Little research is available that investigate globalization, organizations and diversity. These findings are preliminary and suggest a need for research with critical perspectives that pays attention to context and globalization in the study of organizational diversity.

Workplace Learning in the STEM Settings

The current research supports workplace learning in STEM in two areas. First there is a distinct lack of literature with a critical perspective about workplace learning and diversity related to STEM environments (Brooks & Clunis, 2007; Fenwick, 2008). While there are critical perspectives on adult learning theory that focus on power and privilege, most in engineering are unaware of such theories and therefore the notions of inequality and an understanding of the knowledge as subjective and dependent on people's positionalities are hidden.

Lack of critical perspectives on learning in the STEM disciplines. Whether education is formal to gain instrumental knowledge or informal on the job learning that can occur through

observation and mentoring relationships, is important in looking at *who is learning what*. This study highlighted the reliance of on the job learning (including learning via mentors) in engineering occupations. The current literature on women in STEM focuses on mentoring as a source of learning and development. Kowatha (2008) concluded that mentoring relationships are important in developing job skills. Additionally, the lack of mentoring is implicated in women's inability to advance (Monhardt, et al., 1999). However, women's on the job learning experiences are noticeably absent in the STEM literature. As discussed previously, while the women who were interviewed indicated they did learn through these experiences, little to no attention was paid to how those experiences were structured (beyond indicating that in most cases mentoring relationships were informal). Furthermore, the factors that affected employees' accessibility to experiences that were valuable in terms of employees' career development are invisible.

The literature on adult learning indicates that the informal nature of these experiences ignores the workplace as a political institution where access may function to privilege the dominant group. Since on the job learning is critical to engineers' professional development, a more visible structure including a critical perspective of how these informal learning experiences function in engineering environments is desirable. Some theorize that a lack of understanding of the complexity of adult learning, including affective, emotional is responsible for the failure of workplace learning, (Cox, 2001; Kell, Shore & Singh, 2004). Additionally, critical and feminist scholars in adult education are concerned with power structures and challenging dominant ideology; the "belief system, values and practices" (Bierema, 2008; Brookfield, 2004, p. 68; Fenwick 2006, 2008) that appear natural and serve to reproduce social systems that advantage some groups over others. Adult education perspectives could help make some of the issues and

the mechanisms surrounding women's access to these learning opportunities visible. The adult education research on workplace learning explicates issues of gender, race, age and learning on adult education and the connections between dominant ideology and oppression. Critical race theorists examine oppression through the social construction of race (race as a means of differentiation and oppression) and seek to advance a social justice framework. In an emancipatory perspective, critical race theory also aims to redress social inequalities. Additionally, recognizing that race and racism work with and through gender, ethnicity, class, sexuality, etc. as systems of power, contemporary critical race theory often includes these intersections in their analysis (Johnson-Bailey & Cervero, 2008; Ladson-Billings & Tate, 1995; Barrett, Cervero & Johnson-Bailey, 2003).

Knowledge as subjective and dependent on people's positionalities. Workplace learning occurs within a "social system" (Bierema, 1996, p. 22). A fundamental belief that all knowledge, including scientific knowledge is subjective knowledge to some degree, in that its creation is shaped to one extent or another by multiple beliefs is a tenant of a poststructual feminist theory (St. Pierre, 2000). Many of the invisible structures and practices that support oppression may be hidden because of a firm belief in objectivity and a lack of questioning such structures that are often reinforced by natural or truth statements that maintain dominant ideology and hegemony (St. Pierre, 2000). Critical feminist theory, influenced by poststructural feminists also place emphasis on positionality; they argue that knowledge is socially constructed by human beings who are informed by multiple social systems, such as race, class, and age, and not just gender. Thus, the view that all knowledge as constructed, and subjective to some degree, since all knowledge is created and mediated by human experience, and based on the positions people occupy in life resulting in multiple realities (English, 2006). In contrast, the dominant

science narrative views all *real* knowledge as objective, and tends to ignore the fact that scientific knowledge is also created and mediated by human beings through their experience and observations. Consequently, scientific knowledge has tended to serve to privilege those who have traditionally been responsible for knowledge production in the sciences - white men of means. This invisibility of privileging so-called *objective* knowledge marginalizes those who do not occupy positions of dominance and is present in all aspects of life.

Adult education tends to view workplace learning through a critical lens placing value on the subjective nature of knowledge. In contrast, the culture of engineering is steeped in an objective paradigm that does not value plural views of knowledge and views learning as acquiring technical skills (Faulkner, 2007).. In addition to ignoring the different ways in which people learn and a lack of awareness that not everyone learns the same thing the same way, this view of learning and knowledge ignores the affective and may, in part, be a reason for the lack of diversity education within engineering organizations. If cultural competence is not seen as a set of competencies that can be learned, why waste time and money on diversity training? As one African American woman said, "[They think] all you have to do is have good intentions and that makes it true." (Carol). The grounded philosophy of engineering and most current engineering organizations do not support diversity training in theory or practice. An understanding of adult education and critical feminist theory that promotes an awareness of the subjective in knowledge acquisition, and the role positionality plays in learning may support learning about diversity in engineering.

Underrepresentation in Engineering

The major themes in the underrepresentation in engineering literature focus lack of mentors and role models, discrimination, the need to assimilate and an unequal work and family

balance. Additionally a discussion of the need for critical conceptual frameworks appears in the women in STEM rhetoric (Phipps, 2007; Tsai, 2003). The issue of mentors was previously discussed and the findings indicate mentored relationships are a common method of learning and that women do take advantage of these experiences, although access to and the value of these relationships for underrepresented groups is not clear. There was little evidence of the need for underrepresented groups to assimilate. Eighty six percent of the survey participants responded in the negative that they have had to change their appearance to "fit in" and although the women were not asked directly about assimilation, the interviewees did not mention having to change their appearance or behavior as an issue. The current research did support the theme of discrimination as demonstrated in the qualitative findings in Chapter Five, where the women who were interviewed indicated they frequently have to prove their abilities as engineers while their male counterparts are given the benefit of the doubt.

The current research informs and calls into question the common narrative of engineering as inflexible and not family friendly and indicates there is some evidence that women are active agents in their own personal and professional lives. The following discussion will focus in-depth on the themes of engineering as unfriendly to women and the need to explicate a theoretical framework in the research of underrepresentation in engineering.

Engineering: Friend or foe. The survey results as well as the qualitative interviews indicate that some engineering organizations are responsive to their employees' personal and family needs and provide flexible work environments to support those needs. With the exception of the woman who co-owns her own business, all of the women interviewed indicated that their current work environments are responsive to their family needs. However, many of the women contrasted their current environment with prior negative experiences in organizations where they

perceived much less flexibility and attention to work/family balance. It appears as if these women are active agents in organizing their professional careers and sought employment in environments that aligned with their needs. Trauth and Howcraft (2006) consider women as active agents in their own destiny with the capacity to modify the masculine paradigm and highlight self efficacy as a source of perseverance. For example, one African American woman said, "…I've never gone through specifically exclusionary activities that people have had towards me. Maybe they have had some, but I've always…I'm a direct person, so if I see an issue I'll go to the person and I would say something" (Deb).

Some research has begun to question the effect of the proverbial narrative warning women of the difficulties in entering STEM professions. For example, a longitudinal mixed methods study on career development of adolescents with information technology (IT) career aspirations, points to "anticipated discrimination" (Messersmith, Garrett, Davis-Kean, Malanchuk, & Eccles, 2008, p 223) as a major factor in women not pursuing careers in IT. That is not to say that there are not still exclusionary structures and cultures in engineering, as demonstrated by this study, but the survey research also indicated some positive change has occurred and that while less favorable than their male counterparts, (white) women are positive about their careers in engineering.

Additionally, the qualitative findings implicate age as a factor in women's divergent perceptions about the culture of engineering. Age was also significant as a predictor for the cultural climate indices of retention, communication and employee engagement. The qualitative findings indicate that younger women may have more favorable perceptions of their work environment, especially in terms of experiencing overt discrimination. One woman in the 31-40 age group indicated, "But I never felt, at least in the large companies I worked for, any issues

about me being a female. I mean no discrimination or not being wanted in the workforce" (Margie). Similarly another younger (31-40 age group) woman said:

> I don't feel that I was ever – anytime that I felt like someone was not respecting me, I saw them not respecting people pretty much across the board, whether they were beneath them or equivalent in standing. It wasn't because I was a girl or anything like that. I didn't have any experiences like that (Nina).

These findings call for additional research examining organizational characteristics that may promote more inclusive environments, the role of women's agency and resistance strategies that subvert traditional engineering culture, and age as a factor in how women view the climate culture and engineering as a career.

Critical and plural perspectives. The current study contained a mixed methods methodology and as such was able to gain a broader picture of the cultural climate in engineering. The quantitative findings informed the qualitative portion and the integration of the findings in some cases, supported each other, and in other cases provided a deeper understanding of the issue. Theoretical frameworks are frequently absent in studies on underrepresentation in engineering and fewer yet a have employed a plural methodology. This study demonstrates the value of explicating a theoretical framework and a mixed methodology.

Less than 50% of the research studies reviewed explicated a theoretical framework. Of those that did, much of the literature is positioned in a general social constructivist framework examining women's construction of gender (Coyle, 2001; Messersmith, et al., 2008; Miche & Nelson, 2006; Smith, 2000). This study demonstrated the value of grounding a study theoretically and having a critical feminist perspective. This perspective guided the research in paying attention to gender and other positionalities in the data collection and analysis as well as

the interpretation of the findings. For example, the quantitative findings indicated that although still positive, women have less favorable perceptions of the cultural climate in engineering than men. As discussed previously, age was significant for three indices (retention, communication and employee engagement) indicating that those in those 30 and under and those 61 and over have more favorable perceptions. A multiple regression analysis indicated that gender was a significant predictor for all of the indices but did not have a predictor relationship with employee engagement. However, age is a significant predictor for employee engagement. The qualitative findings paid attention to, among other things, race and age and showed evidence of subjective perceptions that may be attributed to those positionalities. Additionally, this attention also highlighted different perspectives among those with similar positionalities. Therefore, a theoretical framework and in particular a critical perspective that pays attention to plurality and subjectivity of perceptions between and among groups serves to: (a) to solidify the research questions that seek information that uncovers invisible structures and power relations; and (b) identify an appropriate methodology so that the data collection is in line with the analysis

Implications for Theory, Practice and Further Research

The theoretical framework that guides this study combines critical and feminist adult education perspectives, informed to some extent by poststructural feminist theory, with an organizational diversity model supported by Rasmussan's (2007) diversity mosaic perspective in organizations. This section will discuss the theoretical implications of the current study for these frameworks, and continue on to discuss the implications for practice.

Organizational Diversity

This was a mixed methods study designed to, in part, measure engineers' perceptions of the workplace cultural climate. Therefore, it was necessary to ground the study in diversity theory

and incorporate an organizational diversity model. The particular diversity model used for the research (Rasmussen, 2007) attends to five cornerstones that make up a diversity initiative: (1) inclusive definition of diversity, (2) business case for diversity, (3) cultural competence scorecard, (4) adoption curve, and (5) diversity enhancement process. While this research did support the desirability of articulating the business case for diversity, particularly in engineering where the norm is objectivity and issues of social justice and equality are not particularly thought of, the discussion was focused on the sustainability of organizations via demographic and geographic pressure and was not a major focus. Two areas of the model were highlighted in this research and are discussed, the need for an inclusive definition of diversity and the cultural competence scorecard.

As discussed previously, the definition of diversity may have an impact on how diversity is perceived in engineering organizations. Some survey respondents may have perceived diversity strictly in terms of gender. Furthermore, because the sample was overwhelmingly white, questions that referred to diverse individuals (meaning diversity in terms of race, gender, ethnicity, etc.) being promoted, treated differently, etc. may have been difficult to interpret. One male survey respondent took exception to the term saying, “We hire humans, not diverse planet people.” Therefore this study supports the need for a well defined definition of diversity.

The current research contributed to the diversity framework by adding to the research base of cultural climate surveys. This study modified an existing workplace cultural climate survey by; (a) researching factors that are representative of cultural climate, (b) performing face validity on the questions designed to measure each of those factors, (c) performing scale reliability on each of the theoretical dimensions (factors) and (d) creating indices to test hypotheses. The diversity mosaic’s cultural competence scorecard contained the factors of

recruiting, retention, communication, leadership and interpersonal climate. As described thoroughly in Chapter Three, after a review of the literature a learning and employee engagement factor was added. In that the ultimate goal is to understand factors that increase employee engagement, it was important to include those perceptions in the data collection. The selected question were then examined for face validity, questions were removed, added and moved to other dimensions as deemed appropriate. Ultimately, there was confirming scale reliability data of the questions selected for the dimensions. All of the dimensions were within acceptable alpha values of >.7, indicating that the questions were sufficiently related to be measuring the same concept. The workplace climate survey that was created can be used and built upon in future research to further investigate the factors that contribute to cultural climate in organizations.

Critical Feminist Adult Education Perspective Informed by Poststructural Theory

The current study was also grounded in a critical and feminist adult education perspective informed by poststructural feminist theory. Critical feminist theory is defined by an attention to inequalities based on gender roles and behaviors with the ultimate goal of achieving gender equality (Chafetz, 1999) and as such was appropriate to attend to the issue of gender, among other things, in a study of diversity and learning about diversity in engineering. Poststructural feminism challenges the notion of binary opposites, including essentialized notions of gender, while acknowledging that power relations and inequality shape an individual's identity, but that individuals also act with agency in their own lives. Thus a poststructural perspective was also appropriate in a discipline where much of the underrepresention discourse has been framed by "women are this and men are that." A fundamental belief that all knowledge, including scientific knowledge is subjective knowledge to some degree, in that its creation is shaped to one extent or another by multiple beliefs is another tenant of a poststructual feminist theory (St. Pierre, 2000).

This also is appropriate when studying engineering. As previously discussed, because of a firm belief in objectivity and a lack of questioning invisible structures and practices that support oppression may result in result in a reinforcement of dominant ideology and hegemony (St. Pierre, 2000). For example, the espoused belief that engineering is immune to racial and gender prejudice or that men are assumed to be competent engineers while women need to prove their skills.

Poststructural viewpoints also critique analyses that create groups and classifications as points of reference and a means of ordering (and making meaning of) observations. These critiques focus on attributing universal essences to categories; that biological qualities are the source of social inequality instead of acknowledging structure and socially constructed categories as agents of oppression (St. Pierre, 2000). In that the current study used a mixed methodology and the data analysis and findings, by necessity, relied on category creation and analysis, it does not fit with a poststructural perspective. At the onset of the study, there was an awareness of the apparent disconnect between a feminist, particularly poststructural, perspective and a mixed methodology. For many researching from a feminist perspective, survey and statistics "are arguably too simplistic to examine the complexity of the social issues being addressed" and are often divorced from their original context and generalized in inappropriate ways (Westmarland, 2001, para. 11). Mindful of these critiques, particular attention was made to qualify the quantitative findings to avoid universal essentializations and the survey contained broad demographic data collection to emphasize people's myriad positionalities. Analysis included the attributes of age and gender which demonstrate that differences within groups of men and women may be present due to other positionalities. Additionally, the qualitative findings certainly demonstrated that the eight female engineers did not always share the same

perspective nor did the six white women or the two African American women. For example, there was evidence that age effected the women's perceptions and possibly because of her past experience in working in male environments, the age she entered the engineering field, and her MBA education, Carol was much more aware and insightful of the social dynamics involved in her experiences of inequality in engineering.

This study contributed to the theoretical lens by using a feminist perspective in a mixed methods study. There have been recent calls in the feminist research literature for feminist research to accept a broader, plural view; to move beyond a purely qualitative approach and acknowledge that feminist research is not so much a method as a perspective and that qualitative and quantitative methods are useful depending on the purpose of the research and the topic being investigated (Hodgkin, 2008; McBride & Mazur, 2010; Westmarland, 2001). Additionally, feminist research that has a foundation of advocacy on a political level, or is "seeking to influence the policy and practice agenda around women's issues might consider types of data that are most highly regarded by the audience they are seeking to persuade" (Hodgkin, 2008. p. 314). Despite this, few feminist research studies use a quantitative or mixed methods methodology. The current study demonstrated that mixed methods research can be both appropriate and successful in feminist research and for research that advocates for women and social justice.

Implications for Practice

There are numerous implications for practice that the study suggests. First, organizations that lack intent and action in regards to diversity initiative are less successful. Those organizations that presented a clear definition of diversity, included a statement about diversity in their mission and goals, demonstrated that commitment by actively recruiting diverse

engineers and paid attention to retention in the form of an individual's development by providing feedback and goals for promotion were more successful in cultural climate change.

Second, there is much to learn about the learning that takes place in engineering organizations and there could be much to gain by incorporating more structure and evaluation in both on the job learning and mentored learning experiences. By paying attention to these learning opportunities and placing value on these experience, as the engineer's themselves indicated their value, organizations could have a more developed, capable and engaged workforce.

Third, in as much employee engagement results in "positive consequences for organizations" (Saks, 206, p. 606) and interpersonal climate was identified as the best predictor of engagement, engineering organizations should pay attention to the climate. As this and other research suggest, employees' "perception of support" (Sakes, 2006, p. 614), treating employees with respect, acknowledging their skills and efforts, providing flexibility and encouraging a culture of teamwork versus competition could result in more engaged and productive employees.

Fourth, as a discipline engineering could benefit from an understanding of plural and subjective views of knowledge. The discourse that suggests somehow, someway engineers and the engineering community are immune to prejudice may, in part, be due to the invisibility of privilege and in part due to the reliance on a purely objective perspective. As the research indicates, women (and women of color) in engineering do have different perceptions than their male counterparts and do have experiences where they felt oppressed due to gender and race (Rice, 2011).

Fifth, engineering work organizations and engineering academic communities should become more engaged. There seems to be a lack of connection between engineers' academic

preparation and their work environment and it appears as if some of the issues with gender socialization emerge in academia. Additionally, it seems that engineering organizations and engineers tend to blame academic institutions for the lack of diversity in engineering and indeed women and minorities are underrepresented in engineering degree programs. Perhaps if these two communities work together, some of these issues such as reliance on a purely objective paradigm, a competitive culture, and unrealistic expectations of the work environment can be relieved.

Suggestions for Future Research

The findings of the study raise some new avenues of research. First, the finding that engineers' and in particular female engineers are satisfied with the flexibility and family support in their worksites need further investigation. This counter narrative, including the role of self agency is promising and needs to be explored further and the question of "Are women's choice (or non-choice) of a career in engineering being influencing by presenting incomplete or outdated assumptions?" needs to be addressed. Future research that investigate how women negotiate work environments and use their agency to seek employment that is more suited to their family role might contribute to practical advice and solutions for women.

Second, the findings that suggest organizational context influences engineers' perception of the diversity environment, particularly the influence of globalization are preliminary and suggest a need for research with critical perspectives that pays attention to context, size and scope, the influence of geographic location and globalization in the study of organizational diversity.

Third, this research examined the relationship between indices of diversity and employee engagement and found that predictor relationships between those factors and employee

engagement exist. Therefore, these results add to the body of knowledge and contribute to an understanding of organizational factors that may be significant in employee engagement. Little research based literature examining the relationship of employee engagement and organizational characteristics exits (Saks, 2006) and given the impact of engaged employees on organizational health, information about other predictors including the influence of gender, race, age, etc. is needed.

Fourth, the puzzling metanarrative that engineering is immune to prejudice needs further investigation. Information on why and how this perception (assumption) is maintained in light of the research that suggests those with positionalities other than the dominant group do experience oppression in engineering environments. As discussed previously, while it was supposed that a variety of factors including invisibility of privilege, reliance on an objective paradigm and reluctance of the dominant group to relinquish power are implicated in the reinforcement, research that focuses on this issue may help to make visible practices and structures that serve to maintain the idea that engineering is above/not affected by prejudice.

Limitations and Conclusion

In conclusion, the purpose of this research was to investigate engineers' perceptions of diversity and the workplace learning environment surrounding diversity education efforts in engineering occupations. The mixed methodology contributed to broad view of the topic by allowing for quantitative and qualitative findings with the ability to integrate those findings. The findings of this study are presented in Chapter Four, Chapter Five and at the beginning of this chapter.

There were limitations to the study. First, the lack of racial diversity in the sample limited the statistical research aspects of the interactions of multiple sources of oppression.

Additionally, the qualitative findings that investigated the intersection of race and gender were limited by the perspectives of only two female engineers of color. Additionally, because of the sequencing of the methodology, organizational context (size and scope) was not considered as significant and not included in the data collection. This proved to be a missed opportunity to gain a broad understanding of the interaction of organizational context and engineers' perspective of cultural climate as well as a possibility to support the limited qualitative findings. Finally, the reliance of on the job learning and mentoring as a learning experience was underestimated during the interview process. As a result, limited data were collected and an incomplete picture of those experiences, particularly in terms of value, accessibility and how they were structured within the organization, was presented.

However, this study had some definite strengths including the methodology and the explicit theoretical perspective. The sample strategy resulted in a near equal distribution of male and female engineers and gender as well as age was significant in a divergence of perceptions and as a predictor value for culture climate indices. The addition of employee engagement as a factor of diversity climates allowed for a more complete understanding of engineers' perceptions of the climate indices interaction with employee engagement. The mixed methods methodology contributed to a more complete understanding of engineers' perceptions of diversity presenting a broad understanding of engineers' perceptions of diversity as well as an in-depth understanding of female engineers and female engineers' of color perceptions. Finally, the use of a critical theoretical perspective required attention to positionalities in the data collection and analysis allowing for findings that identified commonalities, divergence and interactions in gender, race and age.

Based on the quantitative and qualitative findings, a number of conclusions can be drawn. There was strength in the methodology and the demographics of the survey populations supported previously reported underrepresentation of women and men of color in engineering. The sample size for people of color was a disappointing 6%. Unfortunately, this small sample size precluded and analysis where race or ethnicity was a factor. Although, women were also underrepresented in the sample database, a stratified sampling technique was employed to ensure an adequate female sample size. The result of the sampling technique, while ensuring a near equal distribution of men and women, meant the findings of the quantitative analysis primarily reflected a white perspective. As discussed previously, there is little research in the area of diversity and learning in engineering that attends to gender, age, race or ethnicity. A recent study, *The Career Experiences of African American Female Engineers* (Rice, 2011), is a welcomed addition to the literature base. It is also important to note that the sample contained a majority of civil engineers working in a consulting organization context.

The findings indicated that the overall perception of the cultural climate is positive. However, while still positive, female engineers have less positive perceptions of the climate than their male counterparts. Even so, given the common rhetoric that the barriers and obstacles in engineering are extremely troubling for women's personal lives and careers, these results are encouraging. Age correlated for three of the indices indicating that those at the start of their careers and those at the end of their careers have more positive perception of retention, communication and employee engagement. In support of these findings, most of the eight women interviewed indicated they found their current work environments satisfactory in terms of being respected and support of their family responsibility. Age again intersected with

perceptions and in these cases, self agency also seemed to play a role in the women actively seeking environments that fit their needs.

In examining employee engagement in the order of significance, interpersonal climate, leadership, retention, and age were significant as predictors of employee engagement. Gender was not a predictor and these results suggest that factors other than gender are more important in employees' perceptions of how they view their jobs. A detailed discussion of the negative relationship between recruitment and employee engagement can be found in Chapter Four. Concluding remarks on this topic include the possible explanations that in general, the engineering community does not subscribe to an affirmative action approach, feels that it does not suffer from prejudice, and may be operating though a veil of invisibility of white privilege (McIntosh, 1988).

Conflicting survey results on questions that directly addresses diversity are discussed at the beginning of this chapter. Worth noting is the general absence of diversity in mission statements and a distinct lack of diversity training, possibly due to, as discussed previous, the concept that engineering does not need to pay attention to diversity because it is a non-issue and a culture that views training as a means to acquire technical skill. The qualitative findings confirmed this general non-issue feeling, at least among the younger women and in entry level positions. However, some of the participants disputed the notion that engineering did not suffer from as one of them said, "the boy's network" (Deb, Kara).

When the women who were interviewed were directly asked, "What are the ways your organization communicates value for diversity?" the women who worked in larger US based or internationally owned organizations with a global scope more often indicated that there was a diversity policy, evidence of attention to diversity, and/or diversity training, for example "We

have a diversity and inclusion manager" (Deb) and "there are some 'women in industry groups' at [current company] that are even supported by men" (Kara). Alternately, when asked directly about diversity, some of the women employed in the smaller firms indicated there was no policy or visible commitment to diversity, for example, "None. …It doesn't even come on their radar screen" (Glenda) and "I don't know that we make specific point of doing that. We don't have a bound handbook. We have policies…but they are related to health insurance and things like that" (Margie). Although the findings are preliminary, and based on limited data, there does seem to be connection between companies with a global scope and a stronger commitment to diversity. Additionally, these findings inform a larger body of organizational research on the effects of globalization. Unfortunately, this theme emerged from the qualitative findings and was not investigated at a deeper level (i.e. follow-up questions were not asked to confirm or explain a connection) and no data was collected from the survey about organizational size and scope. Future research may well want to further investigate the topic.

The previous discussion in this chapter as well as Chapter Five addressed the positive results regarding evidence of engineering environments that are flexible and family friendly. The survey results as well as the qualitative interviews indicate that some engineering organizations are responsive to their employees' personal and family needs and provide flexible work environments to support those needs.

Ironically, being able to make accurate assumptions is critical to successful engineering designs. From the start of an engineering project where little concrete information is available, to the completion of a project where many of the specifics are known, engineers frequently have to make assumption about a variety of factors. Unfortunately, some assumptions do not reflect current conditions. Similar to causing catastrophic failures in engineering design, those

assumptions that are not an accurate reflection of current engineering worksites or those that are socially constructed and implicate gender with ingrained behaviors may be a source of the lack of progress in diversity initiatives in engineering. This study uncovered an assumed as truth discourse of engineering as above prejudice that has been discussed at length in Chapter Five and earlier in this chapter. Concluding remarks about the "non-prejudiced nature" of engineering include women of color being more aware of racial oppression while white women tended to focus on gender as a source of discrimination and a divergence in the views between older women and younger women. Additionally, the assumption that male engineers are competent while women need to prove themselves as engineers and a disconnect between what women are told or assumed are valuable traits of engineers was discussed. While is not the intent or the scope of this study to investigate the academic environment, there does seem to be an interesting connection between the culture of engineering work environments and the culture and socialization of engineers in their academic careers.

Theoretically, this study contributed to the organizational diversity literature by creating a workplace cultural climate instrument that was based on several research studies and presented scale reliability data for the instrument. The area of employee engagement was incorporated and information on the cultural climate factors that may predict better job satisfaction was included. This research also explicated a theoretical foundation (not common in the literature on women in STEM) and successfully used a critical feminist adult education perspective in a mixed methods study. Few feminist research studies have used a mixed methods (or quantitative) paradigm and it serves broadens the scope of feminist research.

Final Reflections

As a life-long feminist with an awareness of male privilege in my work and private life, I embarked on this research journey, in part as a way to make meaning of my life experiences, and to understand the experiences of other women. This study forced me to examine my own bias and reexamine my assumptions. I learned that subjectivity and privilege and power aren't just words in a book or academic theories; each of us negotiates these labyrinths in conscious and unconscious ways and that the color of my skin and the shape of my body influence not only my perspective, but how I am perceived; that time marches on and that my experiences are not my mother's or my father's nor my daughter's and that the world and social structures are in a constant state of change despite their seemingly static nature.

While some of the findings in this study are disheartening, such as the strong indication that white male engineers' privileges status is invisible (to them) and unquestioned as demonstrated by the perplexing narrative that engineers (presumably because of some characteristic unique to engineers and their profession) are immune to socially influenced bias and prejudice, other findings are encouraging. That overall, engineers are satisfied with their work environments and that some of the women who were interviewed found flexible, supportive and challenging work sites is heartening. It is my belief that tiny steps and individual actions can force great social change and I celebrate the women and men, who every day, through ordinary actions and beliefs affect such change.

Appendix A

Engineering Workplace Climate Survey

Final Engineering Workplace Climate Survey (EWCS)

All statements relate to your present place of employment.
Please indicate the strength of your agreement with 1 being strongly disagree to 4 being strongly agree.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. My company is successful in recruiting diverse employees.	1	2	3	4
2. My company has diverse employees at all levels.	1	2	3	4
3. My company ensures a diverse applicant pool when filling a vacancy.	1	2	3	4
4. My company encourages diverse employees to apply for internal positions.	1	2	3	4
5. My company strongly encourages professional development for all employees.	1	2	3	4
6. I receive valuable feedback on my performance.	1	2	3	4
7. People are rewarded based on performance.	1	2	3	4
8. My organization does a good job of addressing performance problems.	1	2	3	4
9. Benefits are equal regardless of employee group.	1	2	3	4
10. People are promoted based on competence.	1	2	3	4
11. Maintaining a diverse staff is an important factor in fulfilling my company's mission and goals.	1	2	3	4
12. Leadership is clear about the company's direction and goals.	1	2	3	4
13. Leadership communicates how things are going with the company.	1	2	3	4
14. The communications in my company reflect the images, languages and needs of employees, customers and the community.	1	2	3	4
15. I am comfortable in expressing my ideas and concerns.	1	2	3	4
16. Discussing difficult issues related to diversity is accepted.	1	2	3	4
17. Leaders are role models for valuing diversity.	1	2	3	4
18. Leadership has removed or are working to remove roadblocks to inclusion and valuing diversity.	1	2	3	4

	Strongly Disagree	Disagree	Agree	Strongly Agree
19. Valuing diversity is a part of the company's mission and supported by policy.	1	2	3	4
20. Leaders are excellent sources of coaching and modeling.	1	2	3	4
21. Organizational decisions are made at the higher levels without soliciting feedback from all employees.	1	2	3	4
22. My supervisor listens when I have something important to say.	1	2	3	4
23. My supervisor treats me with respect even when I make a mistake.	1	2	3	4
24. I feel respected as a person in my job.	1	2	3	4
25. My work environment is inclusive of all people.				
26. I have never witnessed excluding behaviors such as derogatory jokes, stereotypes, etc.				
27. My organization maximizes potential growth for all employees.				
28. My organization creates an environment where all people can be successful regardless of their diversity (age, race, ethnicity, gender, sexual orientation, etc.).	1	2	3	4
29. Diverse individuals who are promoted at this organization are respected in their new position.	1	2	3	4
30. I am satisfied with my work/personal life balance.	1	2	3	4
31. I have had to change my behavior/appearance to fit into my work environment.	1	2	3	4
32. My company provides job flexibility such as working at home or compensatory time.	1	2	3	4
33. I feel comfortable taking time off of work to deal with a family or personal issue.	1	2	3	4
34. There are role models in my company that I can identify with.	1	2	3	4
35. My organization values learning about diversity.	1	2	3	4

	Strongly Disagree	Disagree	Agree	Strongly Agree
36. In my employment, I have had an opportunity to examine my own assumptions and stereotypes about other ethnic groups.	1	2	3	4
37. All employees at my company receive diversity awareness training.	1	2	3	4
38. My company makes sure all employees have the skills to work with diverse groups.	1	2	3	4
39. My company values relationship skills as well as technical skills.	1	2	3	4
40. My company encourages learning through mentoring relationships.	1	2	3	4
41. It is important to learn the "unwritten rules" to get ahead.	1	2	3	4
42. Diverse employees at this organization take advantage of professional development opportunities at the same rate as non-diverse staff.	1	2	3	4
43. Most of my learning at work is done through informal "on the job experiences".	1	2	3	4
44. Generally, I am very satisfied with my job.	1	2	3	4
45. This organization inspires me to do my best in the way of job performance.	1	2	3	4
46. I really care about the future of this organization.	1	2	3	4
47. In general, I don't like my job at this organization.	1	2	3	4
48. I am willing to go above and beyond what is normally expected to help this organization be successful.	1	2	3	4

Demographic Information:
Please indicate your responses with a check mark and add additional information where asked for or for explanation.

How long have you worked in the engineering field?

____ under 1 year ____ 1-5 yrs. ____ 6-10 yrs. ____ 11-20 yrs. ____ 20+ yrs.

How long have you been employed in your current organization?

____ under 1 year ____ 1-5 yrs. ____ 6-10 yrs. ____ 11-20 yrs. ____ 20+ yrs.

Do you have an undergraduate engineering degree?

____ Yes

In what discipline is your degree?

____ Chemical

____ Civil

____ Electrical

____ Environmental

____ Mechanical

____ Other Please list _____

____ No

What is your work environment?

____ Consulting

____ Education

____ Government

____ Industry

____ Other Please list _____

Age:

____ 30 and under ____ 31 – 40 ____41 – 50.____ 51 – 60 ____61 +

Gender:

____ female ____ male

Race:

____ African American/Black

____ American Indian or Alaska Native

____ Asian

____ Hispanic/Latino/Spanish

____ White

Please indicate any other self identified race, ethnic identity or clarify any above response.

_____

Sexual Orientation:

____ Heterosexual

____ Gay

____ Lesbian

____ Bisexual

Married/Partner:

____ Yes

Does your spouse/partner work? ___ Yes ____ No

If yes, does your spouse/partner work ____ full-time ____ part-time

____ No

Children

____ Yes

____ number of children _____ ages

____ No

Household income:

____ under 25,000 ____ 25,000 – 49,999 ____ 50,000 – 74,999 ____ 75,000 – 99,999 ____ over 100,000

Would you be interested in participating in a face-to-face interview that further investigates these issues? ___ Y ___ N

If yes, please provide contact information

Appendix B

Interview Guide

Interview Guide

1. How do you feel about the current demographics in engineering?
2. When you were looking for your current job, what organizational characteristics were important to you?
3. What types of professional development activities does your organization support?
4. What are the typical ways your organization communicates value for diversity?
5. Can you tell me about an experience where ‘unwritten rules’ or ‘business as usual’ conflicted with your organization’s official policy?
6. How does your organization show respect for its employees?
7. Can you tell me about a time when you felt respected in your organization?
8. Can you give me some example of how your job inhibits/facilitates your family responsibilities?
9. Can you describe a workplace mentoring relationship/experience?
10. Would you describe your workplace as “employee centered” (flat organizational structure) or “leadership centered” (hierarchical) and why?
11. How did you learn to be a good engineer?
12. Can you talk about your learning process?
13. Overall, do you like your job?
14. The survey responses contained quite a few statements that indicated engineering is “color-blind” or does not suffer from racial or gender prejudice; that all engineers care about is how good of an engineer you are and they don’t care about race, gender – whatever. How do you feel about those statements?

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VITA
BRENDA L. FIRESTONE

EDUCATION:
Doctor of Education, Adult Education May 2012
The Pennsylvania State University, Middletown, Pennsylvania
Dissertation (Chair Elizabeth Tisdell)
“Engineers’ Perceptions of Diversity and the Learning Environment at Work: A Mixed Methods Study”

Master of Education, Training and Development, 2002
The Pennsylvania State University, Middletown, Pennsylvania
G. P. A. 4.00/4.00

Bachelor of Science, Environmental Engineering Technology, 1997
The Pennsylvania State University, Middletown, Pennsylvania
Graduated with Distinction, G. P. A. 3.77/4.00
Outstanding Senior Award

Associate of Science, Chemistry, 1986
York College of Pennsylvania, York, Pennsylvania

PROFESSIONAL EXPERIENCE:

The Pennsylvania State University	August 1989 to Present
Senior Project Associate	February 2001 to Present
Program Developer	March 2000 to February 2001
Laboratory Supervisor/Trainer	December 1989 to March 2000
Laboratory Supervisor	August 1989 to December 1998.

Industrial Solvent & Chemical Company York Haven, PA

Chemist	March 1989 to July 1989

Green’s Dairy York, PA

Laboratory Technician A	Sept. 1986 to March 1989