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Thesis or Dissertation Title: Voices of Women Who Stayed: A Case Study of Women Leaders with Computer Science or Engineering Degrees in High-Tech Companies in Silicon Valley

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Month and Year: June 2020

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Voices of Women Who Stayed:
A Case Study of Women Leaders with Computer Science or Engineering Degrees in High-Tech Companies in Silicon Valley

A Dissertation

Submitted to the Faculty

of

Drexel University

by

Claudia Galván

in partial fulfillment of the

requirements for the degree

of

Doctor of Education

June 2020

Dedication

I dedicate this dissertation to my loving family who are my rock,

I love you with all my heart.

To all the women in STEM who have the grit to stay in the field.

To all the parents and mentors who help them along the way.

Acknowledgments

It takes a village! When I was a senior in high school in Mexico City, a programmer came to Career Day to explain what he did for a living. It was my first experience learning about computers; that moment changed my life. I decided to pursue a computer science degree even though I had not taken any of the foundation classes. It was not easy. I came from behind and graduated first in my class. Having a Computer Science degree opened job opportunities in Mexico, Canada, and the United States. I have been able to have a solid career in Silicon Valley reaching Senior Director roles, leading global product development teams. It has not been easy, but I feel I have not worked one day in my life. I love what I do.

For the last 15 years, I have made a priority to help increase the pipeline of women in computer science and engineering. I have volunteered thousands of hours supporting organizations, teaching how to code, mentoring, giving presentations, showing up . . . I decided to pursue a doctorate to better understand what can be done to help women in STEM persist, this is my passion.

The dissertation journey was not easy. I had many personal setbacks, life getting in the way with health issues and losing family and friends. Despite these setbacks, there was never a question in my mind that I would not finish. When the pandemic came around, I made it my priority to complete the dissertation. It took grit.

I would not be here without the support of my loving family, first and foremost Dean and Rheanna for their love and patience. My Mom and Dad for their unconditional love and for providing me with a great example of family values, work ethic, intellectual curiosity, and the best education they were able to afford. To my sister and nephew for their love and support. To my teachers, managers, mentors, coworkers, friends, and my development teams who have made this journey so fun and challenging.

To my Drexel dissertation advisor who never gave up on me, my committee, my editors, and my cohort for sharing their knowledge and feedback.

To all the organizations and volunteers who support women and minorities in computer science and engineering: ABI, SWE, SHPE, Techwomen, Technovation, For Inspiration and Recognition of Science and Technology (FIRST) Robotics. It takes a village!

Lastly, to God for all the gifts, challenges and opportunities I have been given.

Table of Contents

LIST OF TABLES ix

LIST OF FIGURES x

1. INTRODUCTION TO THE RESEARCH 1

Introduction to the Problem 1

Statement of the Problem to Be Researched...3

Purpose and Significance of the Problem 3

Research Questions Focused on Solution Finding 5

Conceptual Framework...6

Definition of Terms..13

Assumptions and Limitations 15

Summary 16

2. LITERATURE REVIEW 17

Introduction to Chapter 2 17

Literature Review...19

Summary 30

3. RESEARCH METHODOLOGY...32

Introduction...32

Research Design and Rationale 33

Site and Population 34

Research Methods..36

Ethical Considerations 44

4. FINDINGS, RESULTS, AND INTERPRETATIONS 46

Introduction 46

Findings 54

Results and Interpretation 80

Summary 86

5. CONCLUSIONS AND RECOMMENDATIONS 88

Introduction 88

Conclusions 90

Recommendations 94

Summary 97

LIST OF REFERENCES 99

APPENDIX A: SV 150 2016 (1-50) 108

APPENDIX B: GENDER PROFILE OF SV150 TECH WORKERS (GLOBAL) 109

APPENDIX C: GENDER PROFILE OF SV150 EXECUTIVES (1-50) 110

APPENDIX D: INTERVIEW PROTOCOL 115

APPENDIX E: INVITATION TO PARTICIPATE 116

APPENDIX F: CONSENT FORM 117

APPENDIX G: PARTICIPANT SUMMARY 118

APPENDIX H: ARTIFACT REVIEW PROTOCOL 119

APPENDIX I: ARTIFACT SUMMARY 120

APPENDIX J: ENGINEERING COMPETENCY MODEL 121

List of Tables

1. Participant Overview 47

List of Figures

1. Conceptual framework..9

2. Model of women in engineering careers...25

3. Case study research method..36

4. Findings that emerged from cycle 1 and cycle 2 coding of the data......................56

Abstract

Voices of Women Who Stayed:
A Case Study of Women Leaders with Computer Science or Engineering Degrees in High-Tech Companies in Silicon Valley

Claudia Galván, Ed.D.
Kathy G. Supervisor, PhD

The purpose of this case study was to understand the experiences of women in any leadership role with Computer Science or Engineering degrees that have helped them persist and advance in their careers in the context of Silicon Valley. The "leaky pipeline" phenomenon has been described as women leaving the Science, Technology, Engineering, and Mathematics (STEM) track at many stages in the pipeline (K-12, secondary, career). It has resulted in underrepresentation of women at all levels of the career ladder, specifically, for women with Computer Science and Engineering degrees in leadership positions. Using a case study research methodology, this study sought to answer this question: Why do women with Computer Science and Engineering degrees leadership positions in Silicon Valley stay in the field?

Ten women in senior leadership roles in high-tech companies in Silicon Valley with at least a Bachelor's in Science degree in Computer Science or Engineering participated in the study. Women in this case study had a job title of Director or above. One-on-one interviews, a review of artifacts, and the researcher's observations of the participants during their participation in the study were analyzed. Four themes emerged from their interviews and artifact review: (a) STEM foundation, (b) grit, (c) Silicon Valley barriers, and (d) career strategies.

From the findings, three results were drawn, suggesting there are intrinsic and extrinsic strategies for persistence in the field. Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley: (a) had early math aptitude and were actively supported by parents and mentors; (b) described mostly positive experiences despite facing social and professional barriers in Silicon Valley; and (c) persisted and advanced their careers using *Grit*.

Recommendations from this study include helping women with Computer Science and Engineering degrees aspire to stay and advance in the field, build their confidence, find passion for the profession, and leverage their support system. A solid STEM foundation can help build persistence. It is recommended to parents and mentors to support the early interest in math and provide a nurturing environment. Recommendations for further research include learning about sexual harassment experienced by senior women in high-tech companies, especially with technical degrees, and how to develop grit.

The leaky pipeline is a complex problem, and understanding why women leave, as well as why women stay, is important. Women need to stay to rise to the top. However, this is not a hero's journey; it will take a village.

Chapter 1: Introduction to the Research

Introduction to the Problem

Women, especially women in science, technology, engineering, and math (STEM) disciplines, are underrepresented in leadership positions in high-technology or high-tech companies in Silicon Valley (Bell & White, 2013). Silicon Valley, a region located between San Francisco and San Jose, California, is widely considered the worldwide center of technology. It has the largest concentration of high-tech companies in the world (DeVol, Klowden, Bedroussian, & Yeo, 2009) and the highest concentration of science and technology employment in the United States (Falkenheim & Khan, 2013), and annually files the most patents in the United States (Rothwell, Lobo, Muro, & Strumsky, 2013). Notwithstanding this high-achieving environment, recent studies have described the limited presence of women in leadership, noting that between 1996 and 2013, the average percentage of women in executive positions in Silicon Valley was 15% or less (Bell & White, 2013, p. 34).

According to the National Science Foundation, National Center for Science and Engineering Statistics (NSF; 2015) Science and Engineering (S&E) indicators, S&E degrees in 2013 for both sexes accounted for 33% of all undergraduate Bachelors degrees. The number of women undergraduates in engineering was 19% while those in Computer Science was almost 18% (NSF, 2015). As found in 2010 (Hill, Corbett, & St. Rose), the number of women working in S&E positions after graduation declines (Bilimoria & Lord, 2014; Corbett & Hill, 2015; Hunt, 2016).

Considerable research has been published on the number of women leaving the S&E professions after a few years. These studies have identified personal and professional barriers that preclude women from advancing in their careers or lead to decisions to leave the profession (Ashcraft & Blithe, 2009; Foust-Cummings, Sabattini, & Carter, 2008; Simard, Henderson, Gilmartin, Schiebinger, & Whitney, 2008). Some other studies have focused on why women in STEM persist (Amon, 2017; Bilimoria & Lord, 2014).

In Silicon Valley, the small pool of women graduates in Computer Science and Engineering has affected the hiring and retention of women in technology companies. In 2014, companies released diversity data for the first time, in 2016 (a) at Google headquarters in Silicon Valley, women roles accounted for about 19% of the workforce (Google Diversity, 2016); (b) Apple's technology workforce was 85% male and 15% female (Apple, 2016); (c) the LinkedIn technical workforce was 82% male and 18% female (LinkedIn, 2015); and at (d) Yahoo (2015), women represented 16% of employees in technology roles. In four years, these companies had made significant progress in their diversity data, gaining on average of 12% increase in the representation of women in their workforce by 2020 (see Appendix B).

Women in leadership positions across Silicon Valley technology companies are more underrepresented. While 83% of the S&P 500 companies have at least one female executive, according to Bell and White (2013), almost half of the 150 Silicon Valley companies reviewed have no female executives (p. 18). While women struggle to access executive roles in all corporate settings, the problem appears to be exacerbated further in Silicon Valley.

Statement of the Research Problem

Women with Computer Science and Engineering degrees are underrepresented in senior and executive leadership positions in high-tech companies in Silicon Valley.

Purpose and Significance of the Problem

The purpose of this research was to understand the persistence and leadership strategies used by women with Computer Science and Engineering degrees to achieve leadership positions in high-tech companies in Silicon Valley. Research participants in this case study included women who held degrees in computer science and engineering and who had served in director-level, vice president, or executive leadership roles in the 2016 list of Silicon Valley 150 companies (SV150; Sumagaysay, Davis, & Willis, 2016)—a selected list of the largest technology companies published annually by the *San Jose Mercury News* (see Appendix A).

Significance of the Problem

Very few women occupy STEM fields and even fewer are in leadership positions. It is an important issue because there is an increasing demand for STEM talent, and women are left behind. In the past decade, the number of STEM jobs nationally grew three times as fast as non-STEM jobs. Moreover, computer occupations were expected to grow by 32% between 2008 and 2018 (Langdon, McKittrick, Beede, Khan, & Doms, 2011, p. 1). Parallel to this growth, there has been an overall increase in the number of women in the workforce in the last 20 years. Despite this growth, the National Science Board (2020) reported that in 2017, women in S&E represented only 29% of the national workforce, compared with 26% in 2003, only a 3% increase in 14 years. Furthermore, their data indicated that men outnumber women in leadership roles in S&E and particularly computer managers (11% women) and computer and information systems managers (24% women). In 2016, in Silicon Valley, only 3.5% of the SV150 companies had a woman CEO, and only 9% had women in executive positions (see Appendix B). Furthermore, a woman has not served as a top technology/engineering/R&D executive in the top 15 companies in the SV150 since 2001 (Bell & White, 2013, p. 51).

It is of utmost importance to help solve this representation problem. There are many benefits to understanding the factors that support women's persistence and career growth in high-technology companies in Silicon Valley. First, having a diverse workforce can increase innovation, productivity, and competitiveness. As a result, companies look for solutions to recruit, retain, and advance women (Ashcraft & Blithe, 2009). Second, women have been an untapped national resource; reducing the dropout rate of women in STEM may help to close the workers' deficit in the United States. Hewlett et al. (2008) concluded that if female attrition in science, engineering, and technology was cut by 25%, the United States labor market would add 220,000 highly qualified workers. Lastly, according to Simard and Gammal (2012), the low number of women in STEM has resulted in employee turnover and diminished innovation and financial returns.

Much has been written on why women in STEM leave the field (Alper, 1993; Blinkenstaff, 2005; Cech, Rubineau, Silbey, & Seron, 2011; Glass, Sassler, Levitte, & Michelmore, 2013), and what companies could do to help retain female talent (Corbett & Hill, 2015; Simard & Gilmartin, 2010; Simard et al., 2008). However, few researchers have captured the voices of women who have stayed in the highly competitive environment of Silicon Valley and achieved senior leadership positions.

Research in the recent decade has further suggested that the United States is at a tipping point to stop the decline of women in STEM. Findings have concluded that role models, mentors, and support systems are needed to stop the decline and help increase the next generation's pipeline of women (Boyle, 2005; Girves, Zepeda, & Gwathmey, 2005; Meier, Niessen-Ruenzi, & Ruenzi, 2017; Van Camp, Gilbert, & O'Brien, 2019). Exploring women's experiences is important; companies like Google, Facebook, LinkedIn, Intel, and others have been taking steps to implement changes in work environments. These changes may help address barriers and attract and retain women in STEM, thus slowing down the leaky pipeline (Blickenstaff, 2005) and helping to advance women in STEM careers.

This case study explored the experiences of women with Computer Science and Engineering degrees in senior leadership positions in the context of Silicon Valley, focusing on the process by which they persisted and grew in their careers. In 2009, President Obama made STEM education a national priority, stating, "Reaffirming and strengthening America's role as the world's engine of scientific discovery, and technological innovation is essential to meeting the challenges of this century" (White House, 2009, para. 3). The findings of this research may help women to stay and grow in their companies to support this national priority.

Research Questions Focused on Solution Finding

The central question of this study was: Why do women with computer science and engineering degrees in leadership positions in Silicon Valley stay in the field? This study further sought to explore the following specific questions:

1. How do women with Computer Science and Engineering degrees who are in senior leadership roles in high-technology companies in the Silicon Valley describe their experiences facing social and professional barriers?
2. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their persistence strategies?
3. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their career growth strategies and how these strategies support their success?

Conceptual Framework

Researcher Stance

Philosophical stance. My theoretical lens draws from social constructivism, where the researcher seeks an understanding of the world in which they live and work, relying as much as possible on the participants' views of the situation (Gergen, 1985). The constructivist-interpretive framework was chosen over feminist theory, as this research is not intended to limit or eradicate gender inequality to promote women's rights, interests, and issues in society. Instead, this research focused on capturing personal experiences, variables, and circumstances of women in leadership roles in the context of Silicon Valley. Taking an ontological approach, I embraced the idea of multiple realities. I sought to analyze differing perspectives, allowing findings and conclusions to emerge in a manner supporting a social constructivist orientation.

Tacit knowledge. As a college student, I studied computer science in Mexico at a time when there were equal numbers of women and men in my computer science classes. When I graduated and moved to Canada, I was surprised to find that very few women were on the software development team I joined. This lack of women in the software engineering profession continued when I moved to the United States and worked at Fortune 500 companies. These experiences have contributed to form my belief that women in STEM face unique challenges, which appear to discourage them from both persisting in the field and, in some cases, climbing the career ladder.

As a woman in management in software engineering working in Silicon Valley for the last 20 years, I have witnessed the underrepresentation of women in technology fields, and my worldviews are influenced by these experiences. More than once, I have been one of only a few women on a product development team at a Fortune 500 organization. As I moved into higher management roles in these organizations, I experienced how small the numbers of women were in the field. As a result, I have dedicated a portion of the last 10 years of my career to support girls and women in pursuit of careers in engineering to sustain and increase women in the pipeline. I am an officer at the Society of Women Engineers, leading the Diversity and Inclusion Affinity Groups. I am a former President of the Society of Women Engineers section in Silicon Valley, former Senior Director at the Anita Borg Institute, and former member of the Notre Dame High School (San Jose, CA) and Archbishop Mitty High School Board of Directors. In these organizations, I have helped drive science, technology, engineering, art, and math (STEAM) initiatives. I have volunteered at non-profit organizations where I mentored, arranged panels for students and parents, and led workshop activities intending to increase awareness of the need for more women in STEM fields. I have personally experienced some challenges as a leader in the field, and I have learned to overcome barriers through anecdotal experiences from others and myself.

Conceptual Framework

Several studies have documented that in general, the proportion of women declines as they rise through levels of the organizational hierarchy (Alper, 1993; Blinkenstaff, 2005; Cech et al., 2011). This decline has been even more dramatic for women in STEM fields. Blickenstaff (2005) referred to women leaving the STEM field as a *leaky pipeline* and suggested that women, specifically in science, leave the pipeline at different stages, starting in secondary education, through college, and after graduation by switching careers. What we know about women in science, engineering, and technology is that mid-career is a tipping point where attrition spikes, with up to 52% quitting their jobs due to hostile work environments and high job pressures (Hewlett et al., 2008). A study investigating technical women in Silicon Valley (Simard et al., 2008) found that the mid-career level is a critical stage where a complex set of gender barriers converge. Understanding the persistence and leadership strategies of women with Computer Science and Engineering degrees who achieved executive team, vice-president (VP), or director roles in Silicon Valley may offer insights to improve the retention and advancement of women in this field.

Three streams of theory, research, and practice provided a foundation for the present study: (a) social and professional barriers affecting the career growth and tenure of women in computer science and engineering, (b) persistence strategies of women in computer science and engineering fields, and (c) leadership strategies of women leaders.

The relationship between each of these streams is depicted in Figure 1 and briefly summarized in the following paragraphs.

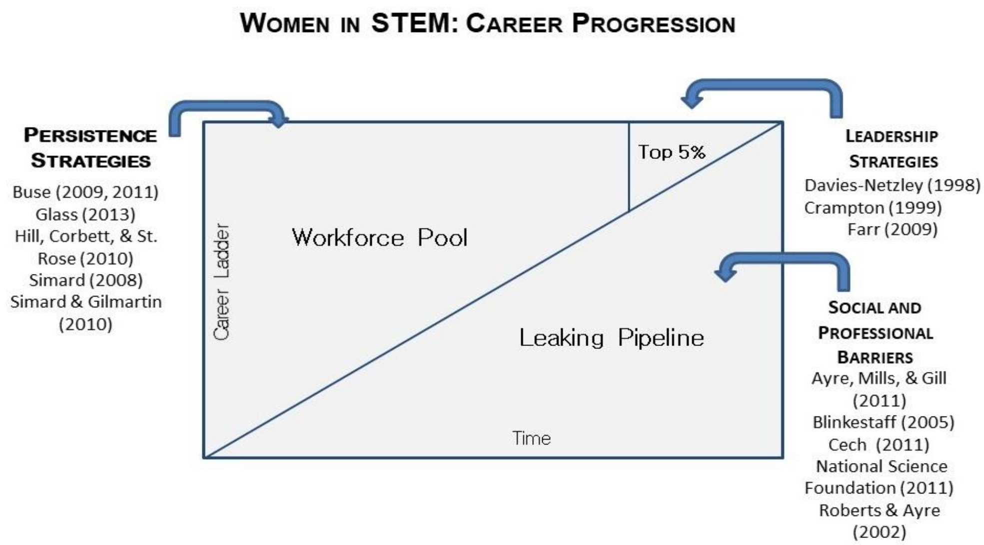


Figure 1. Conceptual framework.

Social and professional barriers affecting the tenure and career growth of women in STEM. Research has concluded that women in STEM face social and professional barriers that have driven many to leave the field (Frehill, 2012; Preston, 1994; Servon & Visser, 2011). When looking at social barriers, social psychological research on gendered persistence in STEM professions has been dominated by two explanations. First, women leave because they perceive their family plans to be at odds with the demands of STEM careers; and second, women leave due to low self-assessment of their skills in STEM intellectual tasks, not of their performance (Cech et al., 2011).

The professional barriers that have contributed to women leaving STEM fields include hostility in the workplace, lack of career/life balance, and a lack of mentors and sponsors (Alper, 2003; Blinkenstaff, 2005; Cech et al., 2011; Hewlett et al., 2008). Senior-level women with computer science and engineering backgrounds in the top 150 companies in Silicon Valley may share these experiences. They may identify additional barriers concerning the unique nature of their location and industry, or they may provide different insights.

Persistence strategies of women in the STEM field to overcome social and professional barriers. Women who complete an undergraduate degree in STEM may have demonstrated a high degree of self-efficacy. "Self-efficacy is defined as a judgment about one's ability to organize and execute the courses of action necessary to attain a specific goal, self-efficacy judgments are related to specific tasks in a given domain" (Bandura, 1997, p. 71). Ambrose, Dunkle, Lazarus, Nair, and Harkus (1997) suggested that most women who graduate from STEM fields have shared experiences with social and professional barriers, and commonalities exist among the persistence strategies used by women who stay and succeed. Results of a study conducted by Glass et al. (2013) indicated:

> Women in STEM are far more likely to exit STEM than professional women are to exit professional fields. After about twelve years, 50 percent of women who originally worked in STEM have exited and are employed in other fields. In contrast, only about 20 percent of the professional women exit professional occupations throughout the course of the study, which spans almost thirty years for some women. (p. 734)

The authors concluded that women in STEM seem to have unique pressures that drive them to exit the field.

Hatmaker (2013) suggested that engineering is not just about being a technical expert; it can also encompass technical, administrative, and interpersonal roles.

According to Hochschild (2003), women engineers engage in a considerable amount of work and emotional labor in constructing their professional identity. Simard et al. (2010) identified eight attributes as most descriptive of people who succeed in technology across all levels and genders: (a) analytical, (b) innovative, (c) questioning, (d) risk-taking, (e) collaborative, (f) working long hours, (g) entrepreneurial, and (h) assertive. Some attempts have been done around women in STEM persistence.

Amon (2017), in a Photovoice participatory study of 46 graduate women in STEM with a third of the sample from international students, identified three persistence frameworks: Motivation, Barriers and Buffers through career narratives on leadership. Bilimoria and Lord (2014) attempted to focus existing research on stories of why women in STEM stay from Sweden, Australia, US, and the Netherlands.

Exploring the experiences of women with STEM backgrounds who stayed in Silicon Valley may enhance the understanding of how they applied both behavioral and persistence strategies.

Leadership strategies of women who move into senior and executive roles. Over 20 years ago, Davies-Netzley (1998) outlined the social constructs women in leadership roles faced, including gender stereotyping, isolation, sexual harassment, blocked mobility, and wage disparity. She identified strategies for women at the top who overcome the glass ceiling including, “developing similarities with male peers, establishing networks with other women and reconciling work and home responsibilities” (Davies-Netzley, 1998, p. 348). Crampton and Mishra (1999) identified individual responses or strategies, including taking the time to develop a career plan, exhibiting skills to succeed in a male-dominated environment, resisting cultural barriers, developing confidence, delegating effectively, meeting deadlines, and exercising the managerial role. Engineers moving into management roles face additional barriers (Farr & Brazil, 2009). Leadership skills for engineers are more complicated because of the additional dimension of technological leadership and governance required. As of today, the number of women in leadership positions has not significantly changed, barriers have remained the same, and women in STEM face unique barriers and skill expectations when moving into leadership roles (Whitney, Gammal, Gee, Mahoney, & Simard, 2013).

As previously discussed, research has identified individual strategies successful women in STEM have used to persist and grow in the field. Studies have focused on what companies could do to retain women in technology (Hill, Corbett, & St. Rose, 2010; Simard & Gilmartin, 2010; Simard et al., 2008). This study was built on Davies-Netzley's (1998) research, which previously captured the lived experiences of women in top leadership positions, and it adds a specific focus on women in leadership roles with computer science and engineering backgrounds in high-tech companies from Silicon Valley 150 Index (Sumagaysay et al., 2016). Because this study has sought to look at the how and why of strategies of women in leadership roles, the case study methodology was well suited. Through analysis of their success strategies, the researcher sought to understand levels of persistence and career growth in the next generation of women in STEM.

Definition of Terms

Career Barriers

Career barriers are defined as "events or conditions, either within the person or in his or her environment, that make career progress difficult" (Swanson & Woitke, 1997, p. 434).

Glass Ceiling

According to the U.S. Department of Labor (1991), the glass ceiling is defined as "those artificial barriers based on an attitudinal or organizational bias that prevent qualified individuals from advancing upward in their organization into management level position" (p. 1). These artificial barriers may exist in the selection criteria used for hiring, or in the selection criteria used for advancement and professional development opportunities or be unspoken in the culture of the corporation (U.S. Department of Labor, 1991).

High-Tech Occupations

High-tech or high-technology occupations are scientific, technical, and engineering occupations, the same group of occupations used to define high-tech industries. They include the following occupational groups and detailed occupations: engineers; life and physical scientists; mathematical specialists; engineering and science technicians; computer specialists; and engineering, scientific, and computer managers (Hecker, 1999).

Leaky or Leaking Pipeline

The metaphor *leaky* or *leaking pipeline* or *gender filter* has been used in the literature on women in science to describe the circumstance that women scientists leave science academia at a greater rate than their male colleagues (Blickenstaff, 2005). The term has expanded beyond academia and is used in other contexts.

Silicon Valley

The region in Northern California extending between and including the cities of San Francisco and San Jose, California, known for being the cradle of high-tech and innovative companies (Hoefler, 1971).

S&E

According to the National Science Foundation, Scientists and Engineers Statistical Data System (SESTAT), scientists and engineers are defined as either those who received a college degree (Bachelor's or higher) in a science or engineering (S&E) or S&E-related field, or those who work as a scientist or engineer or in an S&E-related occupation and have a Bachelor's degree or higher in any field (NSF, 2015). S&E degrees include biological and agricultural sciences; earth, atmospheric, and ocean sciences; mathematics and computer science; physical sciences; psychology and social sciences; and engineering. (NSF, 2015).

STEAM

"STEAM is an acronym for science, technology, engineering, arts, and mathematics" (The STEAM Journal, n.d., para. 2).

STEM

Science, technology, engineering, and math. In this study, limited to computer science, math, and engineering (Gonzalez & Kuenzi, 2012).

Silicon Valley 150

The *San Jose Mercury News* stated:

> The Silicon Valley 150 ranks [public] companies headquartered in Santa Clara, Santa Cruz, southern San Mateo and southern Alameda counties [in California] on the basis of worldwide revenue for the most recent available four quarters ended on or near [the most recent December 31]. (Sumagaysay et al., 2016, para. 1)

Assumptions and Limitations

Having worked in the technology field for over 20 years, I recognize certain tacit assumptions that have influenced my approach to this study. I held five major assumptions supported by existing research, which underlined the structure and methodology of this study. My first assumption was that no differential ability or cognitive difference in learning math and science exists between men and women (Stoet & Geary, 2015). My second assumption was that women who are attracted to STEM fields have intrinsic passion and motivation in the field (Modi, Schoenberg, & Salmond, 2012). They are highly connected to their occupations, love technology, and are seeking to make an impact on the world (Buse, Bilimoria, & Perelli, 2013). The third assumption was that unconscious bias affecting women in STEM fields is likely caused by environmental factors (Nosek & Smyth, 2011). Fourth, I assumed that many women in STEM fields have suffered from unique challenges precluding them from persisting and advancing in the field (Glass et al., 2013). Due to these factors, successful women in STEM leadership roles may have developed unique coping strategies that have allowed them to persist in the field and advance. Lastly, women have been an untapped resource that, if more are brought into STEM professions, this could help close the labor gap in the high-tech labor market (Beede et al., 2011). These assumptions, taken together, are reflective of my mental models and were bracketed during the conduct of this case study, allowing the themes and findings to emerge from the voices of participants. A recognized limitation of the study is that the experiences of Silicon Valley women in STEM may not extend to women leaders in technology working in other parts of the country or world. This small sample may not reflect the experiences of all women in STEM and may not be generalizable beyond the immediate location.

Summary

Silicon Valley has been considered one of the most innovative and diverse areas for technology companies in the United States; nonetheless, there is an underrepresentation of women leaders with STEM backgrounds in leadership positions. A number of factors contribute to a leaky pipeline, resulting in significant numbers of women leaving the field in the first five years of their career. Previous research has focused on understanding why women leave and corporate strategies to retain women in STEM. Central to this case study was learning from the lived experiences of the women with Computer Science and Engineering degrees in leadership who persisted and advanced in their field.

Chapter 2: Literature Review

Introduction to Chapter 2

As described in Chapter 1, of all the S&E degrees granted in 2012, the total percentage of women undergraduates in engineering was 19% while those in computer science equaled almost 18% (NSF, 2015). As these women join the workforce, they fall broadly into three areas: those who at some point decide to leave the field, others who persist and stay in the field, and a few who persist and move into leadership positions (Fouad & Singh, 2011). The purpose of this research was to identify the strategies of the women with Computer Science and Engineering degrees who have persisted and moved into leadership positions in high-tech Silicon Valley companies through the lens of the conceptual framework (see Figure 1).

Contemporary Context

This case study sought to examine the contemporary context of women in computer science and engineering in leadership positions in Silicon Valley. Silicon Valley has the most substantial S&E employment in the United States (NSF, 2013), and according to the Equal Economic Opportunity Commission (n.d.) in the Silicon Valley regions of San Francisco Bay Area and Santa Clara County, women in leadership positions and professional high-tech industries accounted for 21.82% and 17.93%, respectively, for STEM and non-STEM.

Understanding the real-life phenomenon of how women in leadership positions in Silicon Valley, in particular women with Computer Science and Engineering degrees, overcame these barriers and why they stayed in the field is central to this research.

Silicon Valley's regional characteristics of individualism and meritocracy, high velocity of the labor market, business and personal networks, and pressures of work in the high-tech sector were included whenever possible (Shih, 2006). This study sought to explore the following research questions:

1. How do women with Computer Science and Engineering degrees who are in senior leadership roles in high-technology companies in the Silicon Valley describe their experiences facing social and professional barriers?
2. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their persistence strategies?
3. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their career growth strategies and how these strategies support their success?

This chapter provides a literature review as an orienting framework. There has been a recent groundswell of popular articles on the subject of lack of women in STEM; however, not much research has been published on this subject in the context of professional women with STEM degrees, and specifically computer science and engineering in Silicon Valley. This case study sought to provide a broad understanding of theory, research, and practice of available research related to three streams of theory, research, and practice related to: (a) social and professional barriers affecting the career growth and tenure of women in STEM, (b) persistence strategies of women in STEM fields, and (c) leadership strategies from women leaders. This literature review includes peer-reviewed articles, complemented by the inclusion of accredited government and non-profit sources.

Literature Review

Barriers Affecting Career Growth and Tenure of Women in STEM: The Leaky Pipeline

A metaphor frequently used to describe that women are underrepresented in STEM careers is the leaky pipeline, which Blickenstaff (2005) described as the pathway that carries female students from secondary school through university and on to a job in STEM. Barriers are defined as internal or external events or conditions that make career progress difficult (Swanson & Woitke, 1997). Research on women leaving science and engineering careers has a long history. In a study conducted from 1982 to 1989, Preston (1994) identified the most significant differences in male and female behavior exiting from the science and engineering professions were that after the age of 30, only 60% of women stay in engineering compared with 85% for men, and women were 2.8 times more likely to exit than men for reasons other than a promotion (p. 8).

The decline in women in these roles appears due to a number of factors, some of which affect all genders and races, while others apply specifically to women. Women have faced the well-documented "glass ceiling," and additionally, women in STEM have faced specific social and professional barriers. Blickenstaff (2005) compiled the possible causes of the leaky pipeline for women in science and found the causes to be highly interrelated, holding different weights, and increasing the complexity of the problem. These included a range of possible biological differences to lack of mentors, masculine worldviews, and traditional gender roles, among others. Other studies focused on mid-career women in technology suggested that women face professional barriers related to: (a) lack of mentors, (b) lack of access to male social networks, (c) lack of self-confidence, (d) culture, (e) unconscious bias, and (f) work-life balance (Whitney et al., 2013). Swanson and Woitke (1997) noted that they encountered over 1,000 barriers and tried to devise a system to organize them into social-interpersonal, attitudinal, and interactional barriers. For simplification purposes, during this discussion, reference is made here to external and internal barriers.

Lack of mentors. The scarcity of mentors has been determined to be a significant predictor of success for women in STEM (Whitney et al., 2013). Fouad and Singh (2011) found that the majority of women in STEM did not have a mentor; more importantly, those women who did have mentors had higher job satisfaction and lower intention to leave the field or the company. In their study on technical women's career advancement, Simard et al. (2008) found that while mentoring has not been rewarded in high-tech companies, it has been considered important for long-term career advancement. Glass et al. (2013) similarly found that women in STEM lack mentorship opportunities early in their career in comparison with their male counterparts. Mentorship has been found to place attention and planning on career strategies and support for working through everyday challenges, as well as providing candid feedback, which improved both perceptions by peers and self-confidence.

Lack of access to informal networks. Roberts and Ayre (2002) suggested that women are frequently excluded from informal male networks, which provide promotion and mentoring opportunities. Furthermore, Simard et al. (2008) concluded that technical women in low-level positions have limited access to broader networks that may help them advance in their career. Conversely, in the context of Silicon Valley, Shih (2006) described two characteristics of the region. First, Silicon Valley has a high-velocity labor market; high-velocity refers to the career mobility strategies of high-skilled workers who develop their skills moving from company to company. Second, high-skilled workers in Silicon Valley maintain social networks that supply them with job-relevant information and contacts. Even though research suggested women are excluded from networks, the network-based character of the region did not exacerbate ethnic and gender inequalities.

Culture. Roberts and Ayre (2002) found that company culture in engineering companies is frequently both female- and family-unfriendly and has a boys-club culture; this is still true almost two decades later (Fouad, Chang, Wan, & Singh, 2017). The Society of Women Engineers (2016) national gender-culture study from 2014 to 2016 identified four key drivers for female attrition from engineering. First, value-gaps are driving women to attrition in the leadership pipeline. They report greater misalignment between personal and company culture values, specifically in accountability, balance, continuous improvement, coaching, and mentoring, among others. Second, accountability is the number one desired value from senior leaders and helps clarify goals and reduce obstacles. Third, women have a lower tolerance to value-gaps, specifically in creating a shared vision and support systems to achieve the vision. Lastly, there is a lack of shared understanding of gender impact in the diversity discussion (Michaels, 2016). These value-gaps reflect women's perceptions of their environment and may lead to women leaving the field. Additionally, Servon and Visser (2011) found that women in the science, engineering, and technology sectors experienced demeaning and predatory behavior in the workplace. These studies demonstrate how organizational culture influences women remaining in STEM professions.

Unconscious bias. In the high-tech industry, research has indicated that people associate technical and leadership competence with male traits, resulting in an unfavorable bias towards women (Simard et al., 2008). Persistent unconscious biases keep women's representation in technology low (Simard & Gammal, 2010). Explicit bias is decreasing; however, implicit bias continues to affect women's recruitment and advancement. Women who seem competent in a job defined as being a male role are perceived as being less likable, which impacts career advancement, including pay (Hill et al., 2010).

Work-life balance (career/life balance). A high proportion of women working in technology have a life partner who also works in high tech requiring their constant availability, and this takes a toll on career/life balance (Simard et al., 2008). In addition to work, women are still expected to hold primary accountability for family and children care responsibilities (Burnett., Gatrell, Cooper, & Sparrow, 2010; Freehill, 2012). The combination of high-pressure work demands and family responsibilities has been an additional factor contributing to the attrition of women in STEM (Frehill, 2012; Hewlett et al., 2008). For women in STEM, building awareness of social and professional barriers may help them develop proactive persistence strategies.

Lack of self-confidence. Lack of self-confidence develops in early childhood and has often been defined by cultural gender preferences and high competition. Expectations about their own ability to accomplish a task are influenced by the barriers encountered (Swanson & Woitke, 1997). Alper (1993) suggested that this lack of self-confidence is often seen as a cause for women dropping out of the science track. According to Leslie (2016), engineers are expected to have a number of competencies to advance in their career that include both soft and technical skills that some women may find overly demanding. In addition, Locke's (2016) results revealed "that there was a significant negative relationship between perceptions of stereotype threat for women in STEM and their intentions to pursue advancement opportunities" (p. 31). The high-tech environment in Silicon Valley, for example, favors assertive communication styles and rewards competitive behavior and self-promotion. Women have found themselves conflicted with balancing assertive or aggressive behavior with following gender-expected cultural norms (Simard et al., 2008).

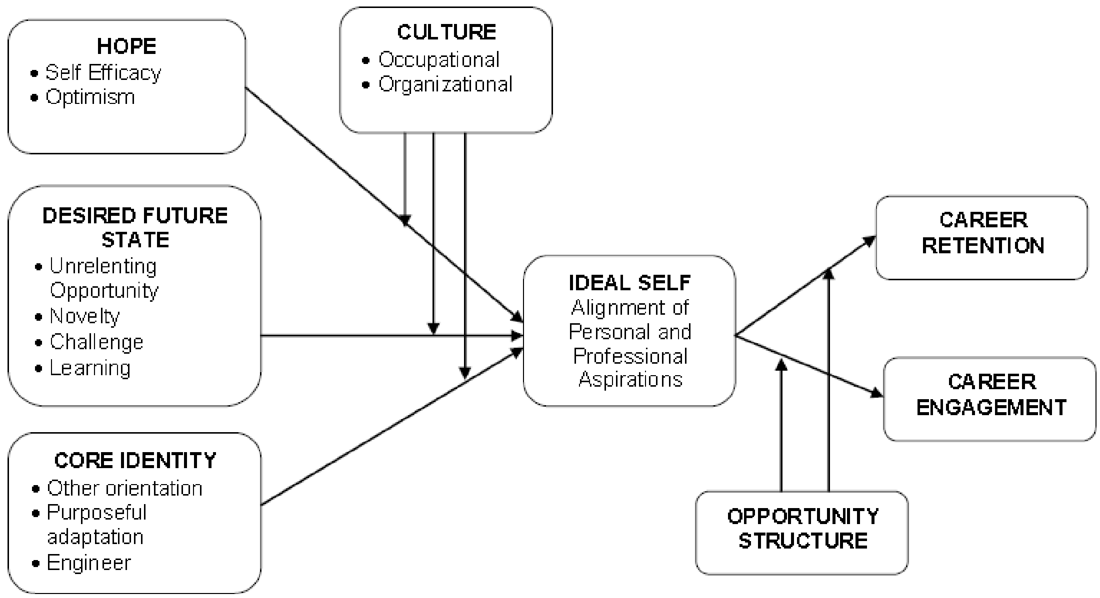
Persistence in STEM Fields

Whereas barriers affecting career and professions concern how women in STEM perceive their experiences, persistence describes how women and organizations approach these barriers. Parallels between persistence in the undergraduate setting and persistence in the professional setting can be observed. In the undergraduate setting, Cech et al. (2011) have described two dimensions of persistence: behavioral and intentional. Behavioral persistence described choices related to leaving engineering for other STEM majors, leaving engineering for non-STEM majors, and persisting in an engineering major and earning a degree (Cech et al., 2011). Intentional persistence referred to a commitment to work as an engineer. Professional role confidence was identified as the best predictor of behavioral and intentional persistence.

Duckworth and Quinn (2009) defined grit as "a trait-level perseverance and passion for long term goals" (p. 166). Their research established that individuals needed both the perseverance of effort and consistency of interest to succeed in the most demanding fields. Adults with grit were found to advance farther in their education and make fewer career changes.

Professional role confidence includes the internalization of cultural and gendered believes and competencies, as well as where "interactive, cognitive, and embodied experiences, form the different levels of confidence in their abilities" (Cech et al., 2011, p. 646). Women's relative lack of such confidence has been found to contribute to their attrition in STEM. A testimony of a woman engineer in Silicon Valley in *Journeys of Women and Science in Engineering: No Universal Constants* explained how she persisted in the field by establishing her technical credentials early on in her career and delaying starting a family (Ambrose et al., 1997).

When looking at persistence, research points to intrinsic and extrinsic factors on why women stay in a STEM career. Buse (2009), in a grounded theory study, "conjectured that a woman's engineering career longevity might be influenced by behavioral beliefs, subjective norms, and self-efficacy moderated by the occupational culture of engineering and the organizational culture of the corporation" (p. 32). The model is illustrated in Figure 2.



Source: Buse (2009, p. 32). Reprinted with permission.

Figure 2. Model of women in engineering careers.

Intrinsic factors included in the theory were hope, desired future state, and core identity (which included having a clear image of career goals and seeing engineering as part of their core identity). Extrinsic factors were described as professional and social systems of career retention, career engagement, and opportunity structure that helped these women persist in their field. In addition, retention strategies for women have been identified as support for STEM persistence. Company strategies for the retention of women included providing a work environment that supports career/life balance, implementing unconscious bias and sexual harassment training, and establishing and reinforcing career development opportunities.

Work-life balance (career/life balance). Career/life balance policies have been found to help retain women in high-tech environments (Simard et al., 2008). A lack of career/life balance for women with families has been identified as a reason for the declining number of women in the field, with women still experiencing discrimination due to maternity leave and return to work plans. Family-friendly places are defined as including flexible work hours, job sharing, part-time work, leave without pay, and paid maternity leave, among others (Roberts & Ayre, 2002). Gender-neutral policies that promote flexibility for both mothers and fathers are necessary (Burnett et al., 2010). Finally, Crampton and Mishra's (1999) recommendations for organizations consisted of time-based programs to enhance career/life balance, attachment programs like parental leave, and assistance-based programs such as relocation assistance and child-care in and offsite.

Unconscious bias and sexual harassment training. Unconscious bias may have precluded women from getting hired and advancing in their careers. Managers can take a proactive role in preventing unconscious bias by providing training opportunities to all members of the team and developing a "gender intelligence" to mitigate the issue (Whitney et al., 2013). With 63% of women who have experienced sexual harassment in the workplace, it is imperative to ensure training is in place (Hewlett et al., 2008). Research by Jackson, Hillard, and Schneider (2014) found that training can have a positive effect on men's perception of women. Simard et al. (2008) recommended company evaluation and performance review to include gender awareness. In California, where this study was conducted, annual sexual harassment training has been mandatory since 2004 (A.B. 1825, 2004).

Career development opportunities. According to findings by Simard et al. (2008), mid-level career development opportunities are considered of high importance.

Simard et al. recommended the establishment of career development policies to enhance technical, managerial, and leadership skills. To close the value gaps perceived by women in STEM, Michaels (2016) recommended potential strategies for action to improve retention and engagement of women, including prioritizing continuous improvement and commitment to learning/growth.

The road to the top starts with one step at a time. The ability to overcome obstacles and persist in the field during the first few years in the STEM field sets the foundation for moving to the next steps. Where workplaces create supportive and intentional environments, women in STEM will also need to develop technical and professional role confidence, which will help them persist and may open opportunities at the top.

Leadership Strategies from Women Leaders in STEM

Women with STEM backgrounds in leadership positions in Silicon Valley are a rarity. In the SV150 of the total women in executive teams, only 3.3% had a STEM degree (see Appendix B). These numbers are partly a reflection of the number of women graduating from STEM fields, as well as a representation of the further challenges that women in technology have faced accessing senior management positions. Simard and Gilmartin (2010) considered that "moving from the midlevel to a senior management position is one of the most critical steps women in the technical career ladder face" (p. 53). As a result, technical women comprise an increasingly smaller proportion in the technical workforce at each successive level (Simard et al., 2008).

In her research on women engineers, Frehill (2012) found that women are significantly less likely to move into management positions. There are a few reasons for this low representation of women in leadership. Eagly and Carli (2007) described the situation of women as leaders using a "labyrinth" metaphor due to the complexity of the situation. In a career setting, bias against women operates with equal strength at all levels in the organization. This bias includes mental associations between men and women, where research points to gender-based agentic and communal behaviors. Two strategies were recommended to overcome resistance to women leaders. First, women leaders should integrate and balance agentic and communal behaviors; secondly, they need to build social capital. Blending agency and communal-focused behavior and establishing an exceptional level of competency may reconfigure conventional ideas about women leaders. This blended strategy can be applied in most cases, with the exception of highly masculine settings, like STEM, where communal behavior may signal weakness (Eagly & Carli, 2007). This strategy is in contrast with other gender role studies, which have suggested that successful women managers may offer unique leadership styles in the workplace. Such leadership styles may include encouraging participation, sharing power and information, and developing a "web-like" structure of leadership (Lindsey, 1997).

Specific studies point to the lack of mentors and executive sponsors, social support networks, and perceptions of success and core work values as barriers to women's advancement to leadership positions. In response to these barriers, Crampton and Mishra (1999) proposed organizational and individual strategies to support leadership development. Individual strategies include enabling mentoring, sponsorship, networking, and adaptive leadership styles. Famiglietti (2015), who studied executive-level women in

Fortune 1000 companies in California, identified that support of role models, mentors, and sponsors was instrumental in career advancement.

According to Simard et al. (2008), the top five attributes of successful people in technology reported by technical workers were: analytical thinking, innovation, risk-taking, questioning behaviors, and collaboration. Women's self-perception of these critical attributes ranked consistently lower on average compared to men's self-perceptions. Likewise, women ratings were also more than 50% lower than men's in areas of innovation and entrepreneurialism. In other words, women perceive themselves as less capable of succeeding in the high-tech environment than men. Lastly, women consistently scored lower on perceptions of rewarded behaviors for successful people in technology, including speaking up, self-promotion, and ambition (Simard & Gilmartin, 2010). Women in technology who make it to the executive suite are aware of these perceptions and may develop strategies accordingly.

Leadership studies on women have identified some common success factors not necessarily related to technology. The study *The Leaky Pipeline, Where Are Our Female Leaders?* Identified that learning from leaders and participating in leadership development training helped women's career advancement (Gender Advisory Council, 2008). However, career advancement can be faced with the "glass cliff," a theory where women are appointed into precarious leadership positions associated with an increased risk of negative consequences that may preclude them from future career advancement (Ryan & Haslam, 2005).

Simard and Gilmartin (2010) found that mid-level respondents (men and women) who had female managers were less likely to describe their managers as having strong technical skills than those with male managers. These responses align with women's self-perceptions of lacking technical skills. These perceptions can be associated with stereotype threat, a phenomenon described by Steele and Aronson (1995) where people's underperformance conforms to expected behaviors from a particular stereotype. In Locke's (2016) study on why women opt out of STEM leadership positions, findings suggested the existence of a significant negative relationship between stereotype threat and internalized sexism for women in STEM and their intentions to pursue advancement opportunities. However, her findings indicated that leadership self-efficacy moderated this effect.

Summary

This literature review provided an account of some of the barriers women in STEM face, as well as strategies for persistence and career advancement. Primarily, internal barriers contribute to diminishing self-confidence in women in STEM, and external social and professional barriers exert pressure in their persistence and career advancement. Women in STEM often lack a supportive environment, resulting in a continuing leaky pipeline. Slowing or reversing this cycle of declining numbers of women in STEM and, in particular, in the STEM leadership ranks, needs a stronger understanding of the barriers and the intentional efforts aimed at creating a supportive work environment. Currently, many efforts are being made to minimize the professional barriers in the workplace; hearing experiences of women who stayed and advanced in their careers complements previous research. Women in STEM in leadership positions have likely been able to overcome barriers through self-confidence building, developing support networks, and mentorships, though other factors could be at work. Much is to be learned from those in Silicon Valley to open doors for the generation to come.

Chapter 3: Research Methodology

Introduction

The purpose of this case study research was to explore the lived experiences of women leaders with computer science and engineering degrees in the context of Silicon Valley and identify their success strategies that could be used by other women in this field to grow and persist in their careers. This study was motivated by the researcher's observations of challenges facing women in STEM in Silicon Valley. The central question that guided this study was: Why do women with computer science and engineering degrees in leadership positions in Silicon Valley stay in the field?

The research questions, as presented in Chapter 1, are summarized here for reference:

1. How do women with Computer Science and Engineering degrees who are in senior leadership roles in high-technology companies in the Silicon Valley describe their experiences facing social and professional barriers?
2. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their persistence strategies?
3. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their career growth strategies and how these strategies support their success?

To answer these questions, this chapter covers the research design and rationale, population and site, description of the methods used, data analysis, and ethical considerations of the study.

Research Design and Rationale

A single explanatory case study research methodology was used to understand in-depth the real-life phenomenon of experiences and strategies of women with Computer Science and Engineering degrees in leadership roles in Silicon Valley in 2016 (Yin, 2009, p. 9). According to the research, the percentage of women in leadership positions in high-tech companies in Silicon Valley has been about 15% (see Appendix B). Investigating why some women with Computer Science and Engineering degrees in leadership roles stayed in the field is the contemporary phenomenon within the real-life context of Silicon Valley that required more exploration and understanding. In particular, this study relied on interviews with 10 women leaders with STEM degrees who have persisted and advanced in their careers. The premise of this research is women who stay develop persistence and leadership strategies to achieve leadership positions in high-tech companies in Silicon Valley (Yin, 2009). This case study includes the following sources of qualitative evidence: Documentation (public available data and provided by the participant); the interview of the persons involved in the event, where the "event" in this case refers to the advancement and persistence strategies used by women with Computer Science and Engineering degrees in leadership roles in Silicon Valley in 2016; participant observation; and physical artifacts (Yin, 2009).

Site and Population

Population Description

The population of participants for this case study was selected from Silicon Valley 150 (SV150), a list of top high-tech companies in Silicon Valley published annually by the *San Jose Mercury News* (see Appendix A). Women included in the study were explicitly selected from STEM disciplines—specifically computer science and engineering—and represented a range of ethnic backgrounds and ages. The interviews were conducted with 10 women with Computer Science and Engineering degrees who had at least five years of experience and had reached a position level of director or higher. When participants were not available in the SV150 sites, the population was expanded to include high-tech company locations outside of Silicon Valley. According to the SV150 (Sumagaysay et al., 2016), Silicon Valley has an estimated total employed population of 1.4 million, of which 26% are employed in high-tech companies. There was not a readily available source for the total percentage of women in high-tech companies in Silicon Valley; however, based on diversity data published by some high-tech companies in the last couple of years, it was estimated that approximately 30% of the high-tech workforce are women (see Appendix B). Furthermore, based on the data analysis of executive teams in the SV150, it was estimated that less than 5% of women with STEM degrees hold an executive leadership role (see Appendix C).

Site Description

Silicon Valley is the geographical area between the cities of San Jose and San Francisco in Northern California and recognized across the world as the center for the worldwide high-tech industry (Rao & Scaruffi, 2013). Sites where women who participated in the study were employed may have included:

1. Google – a multinational software company founded in 1998 with almost 20,000 employees. Google's mission is to organize the world's information and make it universally accessible and useful (Google Diversity, 2016);
2. Facebook – a social networking service founded in 2004, located in Menlo Park, California, with 5,800 employees (Williams, 2015);
3. Yahoo – a multinational Internet corporation headquartered in Sunnyvale, California, founded in 1994, having 11,700 employees (Reses, 2014);
4. Intel – multinational semiconductor chip maker corporation headquartered in Santa Clara, California, founded in 1968 and having 107,200 employees (Intel, 2016); and
5. Oracle Corporation – an American multinational computer technology corporation headquartered in Redwood City, California, founded in 1977 and having 122,458 employees (Oracle, n.d.).

Women in this study worked in leadership roles in these and other 150 SV companies

Site Access

There was no specific site for this study; the women worked for a number of different organizations. The researcher has been a Silicon Valley resident for over 20 years and is active in a number of women in technology groups in Silicon Valley, including the Society of Women Engineers (SWE) Santa Clara Valley Section. To reach senior women in the technology companies, she leveraged personal relationships and professional networks.

Research Methods

Description of Methods Used

Research methodology for this case study followed Yin's (2009) general approach to designing case studies (see Figure 3).

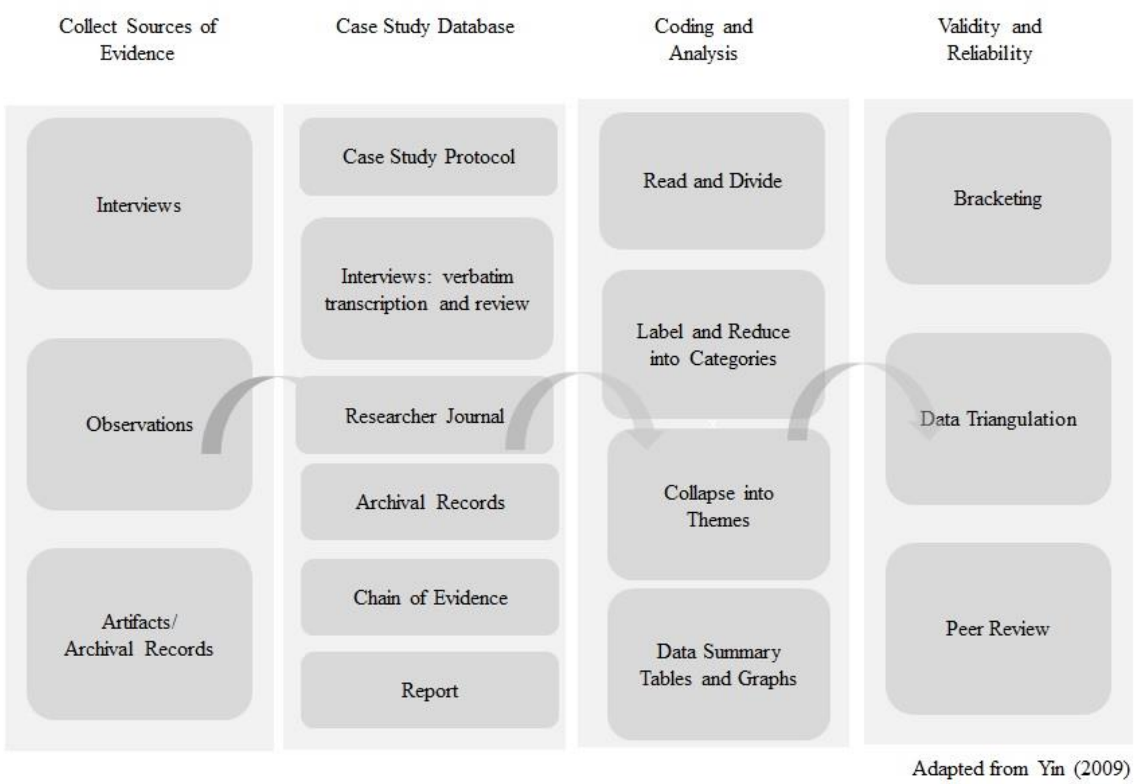


Figure 3. Case study research method.

The researcher adapted Yin's (2009) case study theoretical framework; selected multiple sources of evidence; created a case study database; performed coding and analysis; and ensured validity and reliability through bracketing, data triangulation, and peer review.

Multiple sources of evidence. Evidence was collected from a small participant population via in-person, focused, semi-structured interviews to corroborate specific facts that had already established. Additional sources of evidence included participant observations and a collection of artifacts and archival records provided by the participants in the study or public sources of data approved by the participant (all personal identifiable information was kept private).

Case study database. A case study database was created on Google Drive and Google Docs with directories for each source of evidence. It included transcriptions of the interviews, dating, labeling of materials, the researcher's journal, and archival records. Password-protected documentation of the chain of evidence and the final dissertation was made accessible to other researchers on request.

Coding and analysis. Coding and analysis started with reading and listening to the interviews to ensure the quality of the transcripts, labeling and reducing into categories, and collapsing into themes, finally creating a data summary table and graphs.

Validity and reliability. To ensure validity and reliability (consistency), the researcher used Theory U (Scharmer, 2016) to suspend judgement. In addition, the researcher applied qualitative research methods including, bracketing, data triangulation, and requested peer reviews.

Data Sources

Exploring the lived experiences of 10 women with Computer Science and Engineering degrees in leadership positions in Silicon Valley provided an understanding of their persistence and success strategies. The rationale for this study's research design was also based on several practical considerations. First, because only a relatively small number of women were in senior management positions in high-tech Silicon Valley companies, conducting a wide-ranging quantitative study would have been impractical, and working with a small sample size would compromise such a study's validity. By gathering in-depth data from a targeted group of women leaders with computer science and engineering backgrounds, this qualitative study's research design allowed for a comprehensive understanding of these leaders' experiences, identities, and strategies. Data were gathered primarily using the following three data collection methods: a single one-to-one interview, a review of participant artifacts, and a researcher's journal.

One-to-one interviews. Due to the population size and the limited availability of the participants, the researcher conducted a single one-to-one semi-structured interview with 10 female directors and vice presidents. These interviews were conducted according to the protocol found in Appendix D. Interviews were conducted at a site that offered privacy and best accommodated the interviewees' preferences. Each of the interviews was scheduled to last between 45 and 75 minutes. In addition to the planned protocol questions, probing questions were asked to clarify statements further. All interviews were recorded, transcribed verbatim, and then coded to identify recurring patterns and themes.

Instrument description. In preparation for the semi-structured interviews, a set of questions was prepared ahead of time for each interview (see Appendix D). The same set of questions and interview protocol was used for each interviewee. The interview questions were not designed to stand alone; rather, they provided a framework for the interviews with the leaders while allowing the interviewer to ask follow-up questions and probe for additional information. The interview protocol was designed to create a better understanding of the three research streams and the specific leadership strategies used by women leaders in high-tech companies.

Participant selection. The women leaders chosen for interviews were identified from personal connections and professional associations. These women leaders were selected primarily for the following reasons:

1. The participant was a director, a vice president, or a member of the executive team with a Computer Science or Engineering degree in an SV150 company.
2. The participant had been in this position for two or more years.
3. The woman leader was available and willing to share her experiences for this study.

Identification and invitation. The women leaders in high-tech companies were identified from the published SV150 companies' executive teams, and LinkedIn profiles were reviewed to validate education and experience. Once the women leaders were identified, the researcher reached out to her personal network for an introduction and sent invitation emails and made telephone inquiries to determine if the women leaders were willing to participate in the study (see Appendix E). Interested women were sent detailed information about what the study sought to accomplish and what the study entailed from the participant.

Data collection. Interviews were conducted in a private, face-to-face setting. At the beginning of each interview, two digital voice recorders were activated to capture the interviewer questions and interviewee responses. Each interviewee signed the participant consent form (see Appendix F) prior to the interview. The interviewer followed the framework of the pre-prepared, semi-structured interview questions while also asking follow-up questions. During the interviews, the researcher captured notes and observations, which were used in the data collection process (see Appendix G for form). To ensure data protection, recorded interviews and notes were kept on a secure drive, and pseudonyms were used to identify interviewers' names, job titles, and company names.

Artifacts. The artifact reviews were conducted by gathering relevant artifacts related to the background of the women leaders. Data were gathered from public available LinkedIn profiles, which included job titles and descriptions.

Instrument description. Notes were taken during the artifact review process and labeled by a pseudonym, and an artifact summary form was completed to help organize the information (see Appendix H). For each woman leader, data from her LinkedIn profile and other public searchable sources were analyzed and compiled and then compared against compiled data from the interviews.

Selection. The artifact review focused on artifacts expected to provide an immediate relevance to the experience and professional skills. For all women, a review of publicly available information, including LinkedIn profile, was made and the information summarized. For women in executive teams in the SV150, the Executive Team website biographical information was included as an artifact.

Identification and invitation. During the interviews, women leaders were asked to provide links to relevant documents or links to related information.

Data collection. To identify the particular areas of interest from the artifacts, categories were developed to organize the data. Categories were created before the artifact review and focused primarily on professional skills. Additional categories were added after interviews were conducted and during the artifact review process (see Appendix I for artifact summary form).

Researcher's journal. The researcher used an electronic journal in Microsoft Word format with comprehensive notes to capture observations and reflections during and after the interviews in 2017. Observations included setting, personal objects, presence, delivery, and reflections. Data were collected and analyzed over a period of approximately three months.   Analysis and theme development continued with final comprehensive report in 2019.

Data Analysis Procedures

Data analysis occurred simultaneously with data collection and continued after all data were collected. Interviews were transcribed verbatim prior to the analysis. Triangulation occurred through the use of multiple sources of data. Comparisons of information gathered from the interviews, researcher field notes, and artifacts provide strength to the credibility of the study's findings. All data were coded and analyzed for themes using NVivo qualitative data analysis tools as well as through anecdotal examination by the researcher, according to the three-step process of analysis described by Merriam (2009). The data were coded, codes were categorized, and themes were identified. All data sources were compared with each other for congruency using NVivo data analysis tools as well as by the researcher's own reading and comparison of the themes.

In addition, to ensure the quality of the case study design, the following tests were performed:

1. Construct validity: The data collection plan for constructing validity from multiple sources of evidence included sourcing Linkedin profiles, conducting 1:1 focused interviews, capturing participant observations (researcher being an actual resident of Silicon Valley), and collecting artifacts when available.
2. Internal validity: A set of observed independent and dependent variables were compared with the narratives to identify the differences and outcomes (pattern matching).
3. External validity (replication logic): the sample of 10 women was expected to provide a baseline for analytical generalization to be carried out by future research.
4. Reliability: a readily available case study protocol and case study database allows future investigators to conduct the study, repeat the procedures, and arrive at the same results.

These tests helped establish the quality of this empirical social research (Yin, 2009).

Transcription and review. The first step in analyzing the collected data was to transcribe the recorded interviews verbatim. Once the interviews were transcribed, Bloomberg and Volpe's (2008) process of qualitative case study data analysis was used.

First, the interview was reviewed, and data were explored to identify key ideas. Then the written transcriptions were underlined, and notes were made in the margins to highlight early impressions of the data. Key ideas, themes, and questions were documented using the participant summary form (see Appendix G). This review was completed for each transcription.

As with the analysis of the interviews, the artifacts were analyzed using Bloomberg and Volpe's (2008) process of case study data analysis. First, artifacts were read and reviewed to explore the data and formulate initial impressions. Next, an artifact summary form (see Appendix H) was completed to highlight key data points.

Coding. During the second stage of the data analysis, interviews were reread, and common patterns in the data were identified and used to code the data. Categories and subcategories were created to organize the data into classifications. This was done by creating a table with categories and subcategories listed vertically along the left side and interviewees listed horizontally across the top of the table. As the initial tables were completed, additional categories and subcategories were added as necessary to accommodate the data. Once this table was completed, the participant-level data were consolidated into a graphical representation of the themes. The researcher formulated findings statements, presented participant quotations, and summarized key findings as results. The presentation of this data can be found in Chapter 4.

The artifacts were also reexamined, and categories and subcategories were formulated to code the data. Using these classifications, data from the artifacts was placed into a table to provide a manageable way to organize and visualize the data. Codes were added, eliminated, or collapsed as necessary.

Triangulation. The final stage of the data analysis required synthesizing the findings and linking the results and findings to the researcher's own experience and insights in order to draw conclusions and develop recommendations. The data from the artifacts were compared to the analyzed data from the interviews, which was critical for triangulating the data and improving the study's validity. The conclusions and recommendations are presented in Chapter 5.

Ethical Considerations

This study involved interviewing 10 women leaders of Silicon Valley high-tech companies to discover their thoughts, beliefs, and lived experiences related to this study's topic of persistence, social and professional barriers, and leadership strategies. While the research was designed as a case study and the findings are published, the companies themselves, as well as their leaders, were kept anonymous to encourage the most candid responses by the participants. This research was conducted with the utmost sensitivity to protect the participants' identities and narratives. Pseudonyms were also used for participants to help protect identities. Other identifying names were changed that could potentially lead to the unveiling of a participant who chose anonymity. Participants were encouraged not to discuss specifics of the study with others, particularly naming other participants without the permission of other participants.

Because the Institutional Review Board (IRB) considered this research human subjects research, the researcher was required to obtain IRB certification and approval of the study.

Moreover, because the interview questions revolved around the leaders' experiences, it was not anticipated that any of the questions asked during the interviews would create an unusual level of discomfort or increase the level of stress for the interviewed subjects. Nevertheless, to ensure that an ethical approach was taken throughout the research, a number of actions were taken by the research investigator. The researcher clearly explained to the women leaders the purpose of the study, the methods and processes to be used to collect and analyze data, and how the findings and results would be used. The participants were also informed that they could cease their participation in the study at any time. In compliance with IRB guidelines, this study carefully considered the primary ethical considerations as set forth in *The Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research* (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979), which includes respect for person, benefice, and justice.

Chapter 4: Findings, Results, and Interpretations

Introduction

The purpose of this research was to understand the persistence and leadership strategies used by women with Computer Science and Engineering degrees to achieve leadership positions in high-tech companies in Silicon Valley. The study explored the professional and social barriers they experienced, seeking to understand why they persisted when so many others left the field and how they advanced in their careers.

Participant Overview

Ten women in senior leadership roles in high-tech companies in Silicon Valley (SV) 150 with at least a Bachelor's in Science degree in Computer Science or Engineering participated in the study. Women in this case study had a job title of Director, Senior Director, Vice-President, Senior Vice-President, General Manager, or Chief Marketing Officer. The participants held leadership positions in large, medium, and small companies. Four participants were between 30 and 40 years old, two were between 41 and 50, three were between 51 and 60, and one was 60 plus, with the average age of the 10 women being 46 years old.

Five participants were married with no children, one was divorced with two children, and four were married with children. Their level of education ranged from holding a Bachelor's degree to holding doctoral degrees. Six held a Computer Science degree, and four held Engineering degrees in various specialties. Five of the participants pursued a technical path. A technical path, for this study, was defined as holding a position with "engineering" or "product" in the title, and engineering or product responsibilities and competencies. The other five participants pursued a non-technical path, mainly in the marketing field. Table 1 provides an overview of the participants, including information on their (a) pseudonym, (b) age, (c) family, (d) current job title, (e) academic degrees, and (f) technical path.

Table 1

Participant Overview

Participant	Age	Family	Position	Degrees	Technical Path
Edith	50-60	Divorced, two children	Director of Engineering	BSc Electrical Engineering	Yes
Carol	30-40	Married, No children	Vice-President and General Manager Marketing	BSc Computer Science, MSc Management Science and Engineering	No
Gloria	40-50	Married, No children	Director of Engineering	BSc, Computer Science MSc, Computer Science Ph.D. Computer Science	Yes
Deb	30-40	Married, No children	Director of Engineering	BSc Computer Science and Math	Yes
Ricci	30-40	Married, two children	Senior Director Operations and Strategy	BSc Computer Science and Engineering, MSc Information Security	No
Jenny	50-60	Married, two children	Chief Marketing Officer	BSc Computer Science MBA	No
Mia	40-50	Married, two children	Senior Vice-President of Marketing	BSc Chemical Engineering MSc Material Science	No
Karla	50-60	Married, no children	Chief Marketing Officer	BSc Industrial Engineering	No
Patty	30-40	Married, no children	Director of Engineering	BSc and MSc Computer Science	Yes
Trina	60-70	Married, one child	General Manager	BSc Bioengineering BSc Electrical Engineering	Yes

Participant Introductions

Edith. Edith, was 60 years old and Director of Engineering, and she is confident and independent. She indicated that her parents were poor and did not go to college, but her mother was adamant that her children would. When Edith first began college, she was taking general education classes during the time when technology companies were just getting started in Silicon Valley, and she heard through the school about some opportunities to earn a 2-year technical degree in a science field. She accomplished this and accepted a position as a research assistant.

Working initially as a research assistant did not pay much, and she decided to start learning about semiconductors on her own. With this knowledge, she then transitioned into the engineering group, where she faced some obstacles to job progression that led her to go back to college and earn an Engineering degree. After completing her degree, she received a management role, then was promoted to director and started a family, only taking the minimum maternity leave time. Edith divorced in her 20s and raised her children as a single mother. She continued to grow her career in the technical track and decided to move to a smaller company where she held various Vice President roles. She was then approached by a major technology company to join as a Director, a position she was in at the time of this interview.

Carol. Carol is a high-achieving female engineer whose rapid career growth has already taken her to a senior leadership position. At 35, she is a Vice President and General Manager in Silicon Valley. She recently married and has no children.

Carol's parents immigrated from outside the United States with strong views on education. At their urging, she initially enrolled in Electrical Engineering, but soon found her passion in Computer Science. Working on her degree in Computer Science, Carol had many opportunities as an intern to explore several large companies. Her initial experiences as a software engineer later led her to pursue an MBA in management that allowed her to move off the technical path.

Gloria. Gloria is a Director of Engineering in her mid-40s at a large company she is married without children. She has a natural thirst for knowledge and achievement that manifested from an early age, and she has an intrinsic love for science and math. Her family played an important role in her career choices as well; her parents were well educated and they had high expectations. Her family's focus on education led her to complete a Bachelor's, Master's and Doctorate in Computer Science.

Gloria started her career as a software engineer and continued to build her career in the technical track taking on more and more responsibility. Initially working in the northeastern Unites States when her job required her to travel to the West coast continuously, she decided to move to Silicon Valley, where she had more opportunity to continue building her technical expertise. Gloria started her own company and she consulted for several years.

During this period of her life, she continued to be fully dedicated to her work and continued to expand her technical, project management and business skills working with different products and teams across the world; these experiences prepared her to return to work for technology companies. When she went back to work for a Silicon Valley organization, she jumped right into engineering management where her responsibilities and impact continued to grow. Looking at opportunities to have greater impact, Gloria transitioned to roles with other more technical companies, finally landing the Director of Engineering in a large organization.

Deb. Deb is a 39-year-old Director of Engineering with both Computer Science and Math degrees; she is married with no children. She is highly polished and exudes confidence. Growing up, Deb was exposed to Computer Science early on and soon discovered that it aligned with her natural interests. Her parents encouraged and nurtured her passion, providing her with opportunities and supporting her aspirations. Despite her parents not knowing what Computer Science was, they went out of their way to buy her a computer to further her exposure at home. After college graduation, Deb started as a software engineer and moved into technical management quickly. She has stayed on the technical track with increased responsibilities at each level.

Ricci. Ricci is a Senior Director of Operations and Strategy at a large company; she has a Bachelor's degree in Computer Science and a Master's degree in Information Security. Ricci, in her 30s, is married and has two young children. She projects personal competence and confidence.

As a child, Ricci had a natural ability for math and science and started to code before she went to college. Despite this natural ability, she initially planned to become a lawyer; it was her father who encouraged her to go into Computer Science. Her first job in Silicon Valley introduced her to computer security, a field to which she had not been exposed before that she found very interesting and, later, she pursued a Master's degree in this subject. This early experience allowed her to build her career around a field that then became very much in demand and allowed her to advance in her career to the top of her field.

Jenny. Jenny is a Chief Marketing Officer at a medium-sized company in Silicon Valley, and she holds a Bachelor's degree in Computer Science and an MBA. At 52, she is married with two children. With the confidence of a 25-year industry veteran, Jenny is focused and at the same time empathetic.

Jenny was exposed early to computers and took a programming class that she enjoyed in high school. She initially planned to go into business until a neighbor who was a CEO mentored her, and she decided to get both a Computer Science and a business degree.

Jenny started her career as a computer programmer and early on decided to pursue a non-technical path in Marketing. Having a Computer Science degree has allowed her throughout her career to manage product development and engineering, as well as to establish a marketing strategy creating opportunities for continuous career advancement and raising to the executive suite.

Mia. Mia is a 49-year-old Senior Vice-President of Marketing who is married with two children. She holds a Bachelor's degree in Chemical Engineering and a Master's of Science in Materials Science. She is composed and self-assured with a friendly disposition.

Moving to the United States in high school from Asia, her family had minimal resources; she chose to study engineering as a way for getting ahead. Mia started her career as an engineer, but she moved into technical marketing early on. Having a technical background in a technology company allowed her to advance to senior levels in marketing rapidly, and she was promoted to a Senior Director in five years. As she advanced in her career, in parallel she started a family having and raising twin children.

Karla. Karla is a 52-year old Chief Marketing Officer, married with no children. Starting her studies in Mechanical Engineering, she switched in her sophomore year to Industrial Engineering, a multidisciplinary degree that allowed her to explore different classes from the technical to the humanities. Karla exuded an executive presence and at the same time has a warm disposition.

When she first finished school, she was offered different opportunities and decided to accept her first position as a systems engineer working with customers. Her company quickly identified her strengths in sales and her technical background, and this allowed her to pursue a leadership path and reach executive positions.

Patty. Patty is a Director of Engineering at 35 years old and is married with no children. She received both a Bachelor's and a Master's degree in Computer Science from universities in India. She is focused, confident in her abilities, and projects openness.

Patty described her decision to study Computer Science as fortuitous, noting that a teacher in one of her classes invited her to the computer lab and this gave her an early start. In addition to her teacher encouraging her at school, her parents further supported this interest and allowed her to continue developing her skills at home becoming more familiar with the technology. By the time Patty entered high school, she was already very comfortable with computers and programming.

When she graduated college, she started her career as a software engineer in a startup in India, and after several trips to Silicon Valley, she permanently transferred to the United States. During her fast-moving career, she has filed many patents and is active with community involvement.

Trina. At 66, Trina is a General Manager at a large company; she has been married for 38 years, and she has an adult child. Trina conveys a matter-of-fact attitude. Her long career in engineering gives her calm confidence and evidenced know-how.

When thinking about going to college, Trina did not initially consider a career in engineering because of the small number of women in the field. Still, her counselor encouraged her to pursue a degree in Engineering. After completing her Bachelor's degree in Psychology and Chemistry, and while still in school, she discovered electrical engineering and decided to secure a second Bachelor's degree in the field.

Trina started as an engineer and grew her career at a measured speed, spending long periods of time at each level working with many projects that allowed her to grow her technical skills. This experience permitted her to learn about different areas and work with different people, permitting her to move up as she changed companies and ultimately move to a senior leadership level.

Summary. These 10 women working in senior leadership roles in Silicon Valley presented themselves as competent and confident and demonstrated grit. All had a keen interest in math and science in school and pursued studies in Computer Science or Engineering and advanced business degrees. They pursued technical and non-technical paths that provided different experiences. They advanced in their careers, overcoming obstacles by using leadership skills and making career choices based on their strengths and interests.

Research Questions

The researcher explored the following research questions:

1. How do women with Computer Science and Engineering degrees who are in senior leadership roles in high-technology companies in the Silicon Valley describe their experiences facing social and professional barriers?
2. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their persistence strategies?
3. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their career growth strategies and how these strategies support their success?

Findings

The findings presented in this chapter emerged from the analysis and subsequent coding of data drawn from verbatim transcriptions of one-on-one interviews, a review of artifacts, and the researcher's observations of the participants during their participation in the study. Drawing across these multiple sources allowed for triangulation of the data and assuring trustworthiness.

The interviews were either conducted in person and in some cases over the phone to accommodate demanding schedules required by their positions and family commitments. The women who could meet in person appeared to be keeping a low profile, balancing their level of seniority with the informal tech-uniform expected in Silicon Valley: business casual or dark blouse with jeans. When they walked in, they evidenced a confident smile and stride. Women interviewed on the phone were articulate and sounded self-confident. All were punctual and were ready to get started.

Transcripts were analyzed in first-cycle coding using In Vivo and descriptive coding. The first round of coding involved reading through the verbatim transcriptions of each participant's interview one at a time and coding each participant's responses. In Vivo coding was used to initially analyze the data and identify common codes, categories, and themes. In the next round of coding, the researcher used descriptive coding using the Word Cloud functionally in NVivo to identify repetitive and recurring words and phrases that informed the development of themes and subthemes. In second-cycle coding, the researcher reread each transcript again looking for patterns and cross-validated the emerging themes with significant words in the Word Cloud. The four themes that emerged from their interviews and artifact reviews were: (a) STEM foundation, (b) grit, (c) Silicon Valley barriers, and (d) career strategies.

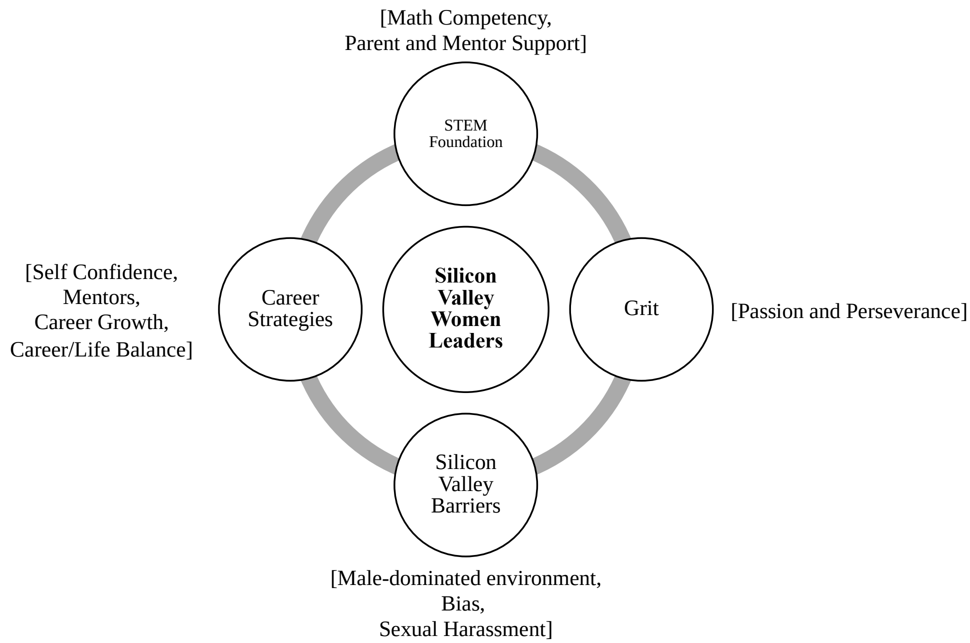


Figure 4. Findings that emerged from cycle 1 and cycle 2 coding of the data.

STEM Foundation

When the participants were asked about why they pursued a degree in Computer Science or Engineering, a common theme emerged about their lived experiences growing up. Fifty percent (50%) of the women in the study described that in school they were very good at math and demonstrated engineering interests early on in their lives. In addition, these participants' parents and mentors supported their interests.

A career in engineering requires math competence and continuous studies to keep up with ongoing developments. Six of these 10 women had a graduate degree in an engineering discipline, and one also held a Doctorate. They described how they relied on their strengths and drove their careers based on what they were good at becoming an expert on. When discussing their parents' role in their pursuit of a degree in Engineering, several participants shared some common experiences.

Math competency. Gloria described her early passion for math and discovery of computer science:

> I think it was natural because I loved mathematics and I was always, since day one, very, very good at math, and also, I really loved the analysis. My initial interest was actually to become a nuclear physicist, so I, you know, excelled in science, in physics and chemistry and mathematics, and in high school, Computer Science was just taking off, in high school. Mathematics was really – which is, I would say, the mother of Computer Science.

Deb was first exposed to computers in middle school, she understood early on that she was good at math and logic, and she felt that Computer Science came naturally to her:

> I think I was good at math, good at logic, and I, yes, I think I'm just kind of a logical person, so it just yes, it came very naturally. Like, I didn't have any trouble with Computer Science, I loved it, I followed it. Yes, it was pretty natural.

Karla, now a successful Chief Marketing Officer, pursued a degree in Engineering because she enjoyed solving hard problems and providing concise answers using a logical mindset. She described enjoying the challenges that drove her to pursue a degree in industrial engineering:

> . . . because it was hard. Moreover, I like solving hard things. I also like getting discrete answers. And I talked about this yesterday as well when I was asked this question. I like getting answers. And in other fields like history or English, it's a little more opinion-based and more interpretive. In Computer Science and Engineering and Math, there is an answer. There may be different ways to get there, but you get to an answer. And that's the way my brain works. I am very logical, and I liked the fact that . . . I might write a program a different way than somebody else did, but there was an answer to get to at the end. So, the fact that it was hard and the fact that I could get an answer were really motivating for me.

Ricci also showed early math ability, and her parents provided her with options that encouraged a career in Computer Science:

> I was really strong in math and science, those were my strong suits, not art and reading and other things [Light laughter], and I wanted actually to go and become a lawyer, and my father said, "You can go and do that after you get your bachelor's degree. I'll help you pay for it if you do Engineering or Medicine," and I ended up choosing Engineering, Medicine was not my path. So, Computer Science was natural for me. I already knew how to code before I went to college.

Parental and mentor support. Five of the participants had seemingly serendipitous encounters with teachers, neighbors, and counselors who encouraged them to explore computers and science. For one participant, Mia, there was an economic incentive to pursue a profitable career, and for another, curiosity about learning more about computers drove the decision to move into the engineering field.

Deb felt she had a natural ability for math and science, and her parents further nurtured this; they were very encouraging of this choice buying a home computer to help her get familiar with the technology and support her passion.

> My parents have been super amazing always; they let me do what I'm excited about and passionate about. And it was new for them because they didn't know anything about it, but they were very supportive, and they bought me a computer which was very expensive at that time to have at home. And so, I was able to get at least more familiar with it, learn more, understand more. And so, they were very supportive, yes.

Patty was walking down the hall in her school when she was seven years old when a teacher spotted her and invited her into the computer lab. This first amazing experience left a lifelong mark for interacting with computers.

> So, she called me into the computer lab, and she sat me down in front of a computer and was, she basically turned on a program called Logo, which is, it's actually a program where you could give a simple command to the computer, like move forward 10 steps and turn right or whatever, and it would execute those commands and draw shapes on the computer. So, it was amazing how you could give commands to something, and it would do exactly what you want it to do, and that was my first ever experience with computers, and I was like pretty much hooked on at that point. . . . Fortunately, my dad brought a personal computer home, so I started spending even more time on computers. So, by the time I was

> in high school I was so familiar with computers, I knew how to program, and I founded my high school's computer club. (Patty)

Some participants transitioned into a different field in engineering based on a number of factors including mentoring. Trina got her first degree in Psychology and Chemistry and then transitioned with a second Bachelor's degree in Electrical Engineering. Trina's counselor played an important role in helping her decide what career she should pursue. Her counselor identified her science ability and encouraged her to become one of the few women pursuing engineering. Trina had misgivings:

> I was actually given a counselor in the chemical engineering department because I was quite good at chemistry, and so I actually thought that I might want to do that, but there were no women, very few women in the engineering teams, and I just didn't feel like I wanted to put myself into that situation. So, I studied the sciences, and I discovered through taking biology and chemistry courses some of the scientific portions that I liked the best.

Carol spoke about her father's influence, as she reflected on following his advice. Her father's clear direction to Electrical Engineering offered her the opportunity to also take the classes in Computer Science that she ended up finding more interesting; she decided ultimately to pursue that as her major.

> He was very prescriptive about what he wanted me to do, and I think at that time I didn't know better anyway. So, I decided to start taking classes in EE [Electrical Engineering], and part of the EE curricula requires you to take CS [Computer Science] classes. And I found CS to just be far more interesting and give me immediate satisfaction because once you code, you can see the results of what you're doing right away. So, I became far more interested in CS than I did in EE. I decided to pursue that as my major.

Jenny chose to study Computer Science when a neighbor provided advice. When describing her decision process, she still remembered this early interaction:

> I took a programming class, and I thought it was fun. I really knew I would probably get a technical undergrad of some type and then get an MBA. I knew I wanted to go into business. But I got the Computer Science degree first. I had

> some advice from someone who was a CEO that was our neighbor, and he said to me, don't go get a business degree. Get a technical degree and get an MBA. So that is what I did.

A professor in college helped Gloria channel her passion and abilities into Computer Science:

> But, having said that, I actually started my degree in physics, and then I was taking Computer Science classes with that also, and I loved Computer Science so much because it gave me the ability to create and be very creative with mathematics. I moved to Computer Science, and my advisor was a very famous professor who was visiting from a different university, an Ivy League university, and he helped me in getting deeper into Computer Science, and that was the beginning of why I landed in Computer Science, where I could really use a lot of analytical and mathematics abilities to be able to create products and programs [Light laughter].

Mia's decision to study Engineering was different than others' and was mostly a financial choice.

> My family immigrated here from China when I was 16 years old, and we practically started from ground zero with no money, no history in the United States and I looked around, looked for what is the highest paying college graduate job at the time, which was the late 90s, and it was chemical engineering so, that's how I decided to pick that.

Summary. These women had a common foundation in their STEM interest; they had a natural inclination early on to math and science. They also had parents and mentors who supported these interests. The participants talked enthusiastically about math and science and their love to solve hard problems and come up with answers. When the participants were provided with the tools to work at home on the computer or use the computer lab, they took advantage of these opportunities.

Their experiences in choosing a career in engineering were varied, but most had a prevalent theme—parents and counselors identified their early abilities and curiosity and supported their interests. The time when these influences appeared ranged from early childhood, in Patty's case and later on in life when Trina, who was already studying chemical engineering, transitioned to Computer Science.

Grit

Women who stayed in the field and emerged in senior leadership roles in Silicon Valley firms evidenced grit, "the combination of passion and perseverance that makes high achievers special" (Duckworth, Peterson, Matthews, & Kelly, 2007, p. 8). This was evident in the stories shared by the participants. The 10 participants had careers that ranged from 10 to 40 years, with an average length of 20 years. Grit appeared as an intrinsic characteristic rather than an extrinsic persistent strategy.

Perseverance. Duckworth et al. (2007) characterized persistence as working continuously towards difficulties and keeping up effort and enthusiasm throughout the years notwithstanding disappointments, misfortune, and plateaus in progress. All the women in the study described that they had faced both social and professional barriers. Despite these barriers, the participants were resilient and advanced into senior and executive positions.

A career in engineering requires long hours, continuous learning, and challenging assignments. Gloria recognized that "engineering is as tough as medicine from a perspective of really being excellent at it, and you have to persevere in terms of the hard work." She explained that to succeed in engineering, you need discipline and persistence and to put in time beyond traditional work hours despite responsibilities at home.

> I've met many, many women, and have worked with many women, who actually would put in the time in the late nights when their kids are asleep, and go and work a couple of hours on solving a particular problem or reading up. I mean, men do it, your partners do it, so why wouldn't you, right? So, you actually have to have the discipline and persistence and that dedication to being really good at

> that aspect, and you have to figure out how you can balance all of your responsibilities to be able to do that.

As mentioned in the introductions, Edith initially earned an Associate's degree in electron microscopy and was working as a research assistant. She taught herself about semi-conductors, a nascent industry at the time. In this industry, having graduate degrees in Engineering was considered a requirement. Despite having developed a deep on-the-job expertise, Edith described facing major obstacles to her advancement, and her manager informed her during an interview that she would never be promoted without a degree. Her recollection of this experience was very emotional and evidenced her determination and grit:

> If I'm going to stay in this industry, I'm not going to tolerate being discriminated against for not having a degree, and not being equally as educated on paper, just so that I can prove that I can hold my own, that I can do just as good work. Because basically, what he was discriminating me on, was the fact that I didn't have a four-year degree. So, I quit. I went back to San Jose State. I finished up a EE in about three years, and I graduated with honors, and I think in my graduating class there were 900 out of all the engineer disciplines, there were 20 women, and out of the 20 women, there were two Caucasians.

Perseverance also included overcoming failures and learning from those failures. Deb started as a software engineer and quickly acquired more responsibility growing her team in two years to 16 people. During this time, she further acquired more responsibility that came with challenging lessons; she described her continuous learning and growing in her career working through difficult feedback and learning not to take it personally.

> If you can kind of get used to like taking that feedback and not taking it personally, and not letting it sort of overwhelm you and kind of get in the way of finding a solution to certain problems, I think it would be much better. I think I've gotten better, much better at [*my company*] than I was, say when I was at [*previous company*] setting, some of it comes with just time and experience.

> Like, there's no substitute, you learn from, you know, I shouldn't have done that, I shouldn't have reacted like that, and it's not something you learn just without going through some of that.

Mia was growing in the organization as she moved from engineering to marketing, learning and making mistakes along the way. She started a family and then had to learn how to balance her career with her new family. She pointed to perseverance as the number one attribute needed for staying and advancing in her career to Senior Director. After the birth of her twins, she made the difficult decision to step back for two years to manage career/life balance however she persisted.

> I had a very fast career growth in my company from the most junior marketing person to Senior Director in five years, and the three promotions, and then I have my twins. And at least for the first year I felt that I was extremely overwhelmed with the new family and my very busy work schedule. I think I felt like that has become my obstacle for not being able to balance, and I took two years a step back in my career just to work through the balance and things in my mind. (Mia)

Passion. Mageau and Vallerand (2007) defined passion as a strong inclination towards an activity that one finds important, likes (and even loves), and to which one devotes time and energy. Deb excitedly described the satisfaction and self-confidence she felt from accomplishing her work and experiencing its impact:

> I think I feel, I'm good at it, and therefore, I feel satisfied. I feel like I'm achieving things, I'm able to add value, I'm able to get products built, and teams built, and it gives me a lot of pleasure to build things up and grow and expand them. So, it's a nice, it's very satisfying to see something kind of come together and have an impact. And so, where I worked has been mostly places where I think, the kinds of roles I've got have been very, they're not just like technical impact as more product and business impact, so I naturally gravitate to those things, and therefore I feel that the engineering and the technology is kind of helping towards that impact. And yes, I feel like I'm, it just basically, I feel like I'm able to do a good job and it gives me satisfaction. So, that's really, like I feel confident, I feel like I can be independent. I am self-sufficient, I don't need to depend on anybody for anything. You know, I'm compensated well because of that and it just makes me feel very, just independent. Like, I don't want to be dependent on anybody so, that's, there's that.

Edith had lots of ups and downs during her career in engineering, but her passion for the field was ingrained in her. She considered herself an engineer at heart and did not see herself doing anything else.

> When I got into engineering, I actually happened to be very, very good at math and science, and actually mechanical engineering. I almost completed a minor in mechanical when I was doing my undergrad. So, as far as what area I was in that fit for me, I'm an engineer at heart, so I don't do engineering at work and then go home and do something else. I am an engineer 24/7. I build cars, you know, build houses. So, at my core, I'm an engineer. It's who I am. At my core, I'm an engineer. It's who I am. So, if I hadn't stayed in this industry, I would have went into something else that would have been engineering-ish in some other way, just because this is an area that fits for me, one I like, and how I do it.

When asked about why they stayed, the participants described not only having perseverance and passion, but they also described their work experience as fun. Karla had a solid career in product and marketing and despite the barriers; she described her experience as both fun and rewarding:

> I spend a lot of time on the product side, and I'm proud of that, because, I think, at the end of the day, the companies I've worked for, they sell products and they sell the company. So, you're selling the product that's gonna' solve the customer's problem, and the company reputation. So, the fact that I've had my knees deep in the products throughout my career, I think, has been very fun and very rewarding.

Trina reflected on her experience in engineering, which can be very taxing; however, she portrayed it as a very creative environment where you are working with very smart people solving big problems, and this makes it fun.

> I had fun. I got to work on some really amazing, fun technical projects. I started when GPS wasn't even an authorized system to use for navigation, and so I got to work on fun technology. I got to work with extremely creative, curious people, and I got to be challenged. I got to work on something nobody else had ever worked on or knew how to solve, and I was given these problems that I was able to solve, and I was able to keep intellectually stimulated and curious with everything I worked on . . . So, I decided to stay, mostly because I've had fun, and I've been able to travel around the world. I've been able to meet incredibly interesting people, and do some really fun, interesting things.

Lastly, Patty very much enjoyed her experience working in engineering; her team and the projects made her work fun.

> So, you know, staying on in my career wasn't about you know, fighting against adverse conditions and staying on. For me I was able, I was lucky to find a team and people and projects that I really like enjoyed working on, so that work wasn't work. I found, every team I worked with I was able to find a core group of people that were more like friends and less like colleagues and that made work fun. It was fulfilling. I was rewarded for what I was seeing. I was able to see forward progress for myself and all of that coming together made it an enjoyable experience for me to continue working.

Summary. Perseverance and passion were evident in the stories of the participants. When talking about their careers, these women overcame obstacles, which included working long hours, juggling jobs and family, and experiencing discrimination and failure. Despite these challenges, they described their career as challenging and fun. Fun was a common theme that fostered their resilience and persistence and related to why they stayed when other women left the pipeline. Jenny summed it up; when asked "why she stayed," she simply said, "Because I love my job!"

Silicon Valley Barriers

Much has been written about the barriers that women in Silicon Valley technology face, and familiar themes emerged from this research. The participants experienced a male-dominated environment and bias, yet surprisingly, only one participant reported having experienced any kind of sexual harassment.

Male-dominated environment. Women in engineering account for 18% of the graduates in engineering. It is, therefore, not surprising that eight of these 10 participants experienced being the only woman on the team during her career. Gloria said, "I was the only woman engineer most of the time on the teams, and it was literally almost as if you were kind of always facing the odds." She further added:

> So, I think that again, whenever there are decisions taken for promotions, for example, in management, there are larger reasons at work, right, and what that means is that there are larger factors that are affecting how engineering management promotions are done, and this exists pretty much in every Silicon Valley company, it's not only technical excellence that matters, it's not only how good you are in being able to communicate and collaborate and facilitate and provide high impact projects, it also is who you know, and that is where I see there's a major barrier, because if you're a woman, you don't, most of the time, have peers or senior women in the management chain, and you're not the typical white male that has a club around them, and so you're not part of a club, and at that point, you really see that your social influence is affecting [your career advancement]. You may be the best and most qualified person in the entire group, management team, but you may still get passed over for promotions or for getting more responsibility, because you're not part of the club.

Edith described her college experience as one of the only two Caucasian women in her graduating class of 900 (with only 20 women total) and how that experience was both an obstacle and an advantage:

> So, many, many, many of my classes, I was the only female, and I was the only blonde, and so I got to know many of my professors. I mean, at a point, you just get singled out. I mean, everyone knows who you are, because you're the only one. So, I got to develop very good relationships with my professors, and I mean, in general, it had its pros and cons. I mean, in one, it got tiring to be around nothing but . . . there's no women in the degree at all, and then, on the other hand, everyone knew who you were, so, it was a trade-off.

Trina has had a long career in engineering. Early in her career, she first experienced being one of three women in a team of 100 engineers, and she described having a manager who did not trust her work because she was female:

> In my first position at [*previous company*], I had a manager who said, "I've never had a woman report to me before," and he'd never worked with a woman before, which didn't seem like a good way to start off a career, and he had people come to look over my work . . . My husband was in school, I had a child, so I was the sole support for family, and in a group of 100 engineers, where at the time I was one of two women, and became one of four at some point in that time period. There

> wasn't a lot that could be done that I could see to be able to change it. So, I decided to leave that group and start looking for other positions in a different group.

Carol summarized the common experiences succinctly across most participants. "I've always worked in technology, so naturally it has just been pretty male dominated everywhere I've been, especially in my role."

Bias. Several participants described how they persisted in the field despite experiencing bias. Bias was experienced by some as a lack of career opportunities and pay differences; others did not consider that they experienced bias or they described that they only started experiencing it after they moved into more senior roles in the organization. Gloria did not feel she experienced bias at the beginning of her career, she was strong technically and indicated that this protected her. Once she was promoted in the organization, she started to experience more social discrimination:

> Because I was, as an individual contributor, very, really excelled in some of the areas that I was working in as a software developer, as a systems analyst, as a requirements gatherer, working on program initiatives, or even as an entrepreneur, I actually could carve my own way, and I did not feel so much of the bias that, you know, one could potentially feel. But, as I went into larger organizations where I was in engineering management and taking decisions from a revenue as well as a technical level, where decisions become political, there is more social discrimination, you would say, and that's where the barriers are more noticeable. So, I would say as you move up in management, these barriers are a lot more prominent, and a lot more driven by other reasons other than technical or knowledge excellence.

Ricci understood the dynamics of the male-dominated environment and unconsciously held herself back (intrinsic barrier) from advancing in her career.

> I think there were times in my career where I was either maybe not motivated, just because I felt like I could do what I'm doing right now, and I don't see any kind of career path for me anyway, because this guy that I'm working with or the people that I'm working with are always going to be the shining stars. I've always worked in very male-heavy cultures. I mean, my [*previous company*] was

> a boys' club, and that's all it was. They all knew as a female you were not going to; there was no career path for you there at [*previous company*], similar kind of culture, actually.
>
> And then, [*previous company*] was when I snapped out of that, and I think I realized I'm holding myself back. I'm letting these boys' clubs and all this stuff, like what stopped me before? I heard these guys like, "We're all going to go out," why didn't I just say, "I'm coming too," or just show up? [Light laughter]. So, I realized it was my own fears, my own doubt, my lack of confidence, maybe, that held me back, and that's what I've kind of realized, and then when I started asking for things and started kind of getting there, I don't hold myself back anymore. (Ricci)

Karla was on the product and marketing side, and this too was a male-dominated environment. She described her struggle to get a seat at the executive table and having a discussion with an executive who was unaware of his bias.

> And I've certainly had that kind of challenge over the years. I also had a challenge in a company that was all men, I was one of two or three senior women. It was a bigger company – about 8,000 people – where, as the head of marketing, I didn't report to the CEO. And the COO of the company looked at me and goes, "Do you think you've earned the right?" and I looked at him, I said, "I've been doing this for 25 years. Yes, I think I've earned the right, and would you be asking me that question if I had different anatomy?"
>
> And he kinda' looked at me, like, "I can't believe you just asked me that question," because he was kind of one of these people that wasn't challenged, typically. So, I think, in that circumstance, I wasn't given the opportunity to best do my job. And I'm gonna' have to say, I think it was a gender bias issue. And interestedly enough, the gentleman who took the job after I left certainly got a seat at the table. And so, that was kind of telling.

Surprisingly only one of the participants believed that being a woman affected their earnings. Jenny described that there was a difference in how women and men were paid for the same work. "I feel like if I was in the same role with the same title and I would have been a guy, I would actually have had a different title and probably more money." None of the other nine participants brought this up.

Sexual harassment. Only one participant reported sexual harassment, Edith indicated that she experienced sexual harassment repeatedly throughout her career, noting that she just "dealt with it" because she wanted to blend in and not make it an issue. She was, however, very emotional when talking about her experiences.

> Well there was, as I mentioned before, I went through lots of that in the beginning of my career, because you're not viewed as an engineer, you're viewed as a woman. Men make advances, you end up having to deal with that, and you have to deal with just the circumstance. . . . Well, I think like anybody, you don't want to be viewed as different. I did this up until maybe the last, I don't know, 10 years of career, is you really want to fit in, you don't want to be viewed different. You're tired of being singled out. The difficulty on that is, so when those advances are made to you, you just don't want to make a big deal out of it, because you don't want to be seen as the troublemaker, the one that because you're different, you just want to blend.
>
> As I moved up in the ranks, I never wore a dress, you know, you always wanted to be one of the guys. I could remember finally, a very good friend, who at that time was VP of HR, and she came up to me and said, "Do you know the best thing you can do for yourself is quit trying to be one of the guys. Be yourself. Be a woman." I'd say, that was probably the first point where I really felt like [the] industry was beginning to value the fact that you could be female, and they actually valued the fact because you're female, you could bring a different perspective. I mean, prior to that, I don't think it really was kind of the universal that they wanted the women to come in with a different perspective. They really wanted the women to come in and blend.

Summary. The participants all described how they succeeded in a male-dominated environment and their experience of gender bias. They all recognized that there were few women in the field and, more so, few women in leadership roles. While they experienced bias, they were able to succeed and move ahead. Their challenge was sometimes how they held themselves back by their own attitudes. The most striking finding was that only one participant reported experiencing sexual harassment. This is in contrast with the popular narrative of the #metoo movement.

Career Strategies

These 10 women described their career strategies as drawing on a recognition of their competence, being mentored, making conscious career moves and decisions to support work life and family balance.

Competence as the basis for self-confidence. As noted earlier in this chapter, having an early interest in math, perseverance, and passion in their careers, and holding a Computer Science or Engineering degree helped these women evidence strong competency in their roles and display self-confidence. Their confidence in their technical abilities helped lower the barriers they faced in early their careers. These findings are consistent with previous research where work success is attributed to skill of ability regardless of gender (Heilman & Guzzo, 1978).

Gloria described that having built software herself and having a strong understanding of the product and technical issues made her technically strong and that helped her during her career. In her own words, "The question is if you're technically very strong, or if you're technically very good at what you're doing, and you're aware of different aspects, some of these barriers are lowered." Karla's engineering competence similarly added to her confidence and credibility. Having direct experience programming allowed her to challenge engineers on their estimates when she was a product manager.

> I also really spent a lot more time leveraging my technical background, because I was helping run an engineering team, even though I was the product manager. I needed to understand how to write requirements, documents, how to lead engineering meetings, and also how to not be BS'ed. Quite frankly, by engineers who told me, "Oh, doing that's really hard." And I'm like, "Oh, really? Isn't that just a simple sort of algorithm? Don't you have that in your bag of tricks?" And they looked at me and said, "Wow, you know what you're talking about." So, that was a time—and it still sticks with me 20-odd years later—that my engineering background, the fact that I had written code gave me credibility with

> this team and helped me really relate with them better, and also not be snowed by what could and could not be done.

For Carol, having a technical background was the basis of everything she accomplished. She had decided to go into Electrical Engineering because of her parents, but once in the career, she pivoted into Computer Science. During her internships, she realized she did not want to work as a software engineer; however, through her career, she advanced because of her technical knowledge in Engineering.

> Pretty much thought from those experiences that I didn't want to go get a full-time job as an engineer or a software developer. So, I thought about what I could do to try to pivot a little bit, but make sure that I could still leverage my technical background. So, I pursued my master's in Management Science and Engineering with the intention of getting into consulting, but with a technology-driven consulting practice and company. . .
>
> That was really kind of the key, the basis for everything I've been doing in my career is that technology background. So, that's how things have evolved, and you know, to a great extent, I still leverage my technology background even today, especially as CEO of a very technical type of company in enterprise infrastructure SAS. And I found it incredibly valuable for my knowledge and learning and being able to do a lot more in other areas because of it.

Ricci described that when she started in the field, she ensured she built up her knowledge, and when she started a new job, noted that she had a steep learning curve and worked on building up competence to build her credibility. Her technical background allowed her to dive deep into the new areas and close the gaps.

> I didn't know information securities, so I picked up every book on the shelf at the time, read everything I could, got as many certifications as I could in Infosec at the time, and felt confident that I actually really like this field, I just need to go find the right position for myself . . . I have to study really hard in an area to make sure I come up to speed, can understand everything, can speak to everything, but not just speak, I have to get hands-on again, which I haven't done in years. So, I had to come here, get hands-on, really understand it, and then prove myself as a leader by doing, by earning the chops and showing that I could do it better, too, I could lead through it.

Mentors. Six of the participants in the study reported having mentors or advocates; many described most of their managers in a favorable light and discussed how they helped them at the beginning of their careers. Having good managers helped the participants have positive experiences in their careers was a commonly voiced theme. In her first job, Gloria was assigned into a special fast-track program that allowed her to work on special projects and have high visibility in the organization. She described her experience with her managers as being pivotal to succeeding in the field.

> I also had the great, great, good fortune of actually having some of my original managers, technical engineering managers, as being really good managers. I think that's very key, and when newcomers are coming into the industry, even as smart people, smart engineers, you really need to have very supportive management to actually succeed.

Mia described she did not have a mentor in an official way; however, her managers were instrumental in her career, acting as mentors supporting her and providing guidance at all her stages in her career. When asked about if anyone guided her in her next career steps, she recalled a particular example when her manager provided her with leadership advice on building relationships.

> My manager, a few of them along different stages of my career [helped me.] I thought [they] have made a significant impact in my career and they're not female, because female is very rare in the leadership role. That's why I believe that having somebody who has the right skill, who has the right leadership, the influence is really, really helpful. For example, early on, my manager helped me to understand the importance of people relationship. For example, I was a junior in my marketing and I would go to somebody's office and say: hey, can you do this for me; and then he said well, do you know that people are willing to do it because they're human, they like you, or emotional connection with you, so asking someone, you need to make sure you go there and have a relationship first.

Jenny always felt she faced professional barriers, not directly associated with her gender; however, she was able to navigate these barriers with the help of a mentor who provided advice and advocated for her.

> But then I had a mentor who was the Chief Legal Officer at the company. And he really helped to advocate and make sure I was making a big structural change in the way that we measure the PNL in business as a GM, so that we could do a turn around. And he advocated for me with the board and with the executive team.

Trina experienced many barriers during her career; however, she still found managers along the way that provided opportunities for her to advance in her career.

> I had the opportunity to work with someone on a part-time basis, and then I was able to move to the section manager at [*previous company*], who I eventually followed to go to [*previous company*], and I felt like he gave me opportunities I would not have had otherwise. He valued diversity enough that he knew that he needed to have different types of opinions around him and he wanted to hear those opinions, so I felt like my value was being recognized, but I had to leave what I had been doing and move someplace else where I could find that. I was able to go to the management series at [*previous company*] because of him. He was the first manager who told me that I needed to make myself more visible.

For Ricci, her manager was a pivotal figure in her career. She always felt she faced professional barriers, not directly associated with her gender; however, she was able to navigate these barriers with the help of a mentor who provided advice and advocated for her. He helped her build her confidence, find her passion, as well as make decisions along the way.

> I was reporting to the CISO who was my mentor, my sponsor, and one of the best bosses that I've had in my career. Had it not been for him, I don't think I would be where I am today, because he really helped me find my passion and my career, helped me find what I really love to do, and showed me that I think I just gained confidence that I can do whatever I want, and especially in a leadership role like that.
>
> I was about to accept somewhere else, and he said, "Can you hold on to that acceptance, because I think it would be good if we could work together and build a team, rather than we split." We had worked together at [*previous company*], as well as as peers for almost eight years, and so he said, "I think we

> can come together and build a really good team. If we split, it's just not going to be the same," and so I ended up actually joining at [*new company*] and taking on a new role here.

Recognizing their competence and building their confidence was helpful, but frequently these women also needed managers who mentored them and advocated for them, helping them recognize that they needed to consciously make themselves more visible and help others become aware of their talent.

Career growth. The participants in this study currently hold senior-level positions in their companies, and their career progression has resulted from a combination of determination, personal decisions, performance, as well as managers who supported their career advancement.

Mia had fast career advancement, from the most junior person in her team to senior director in five years. Mia described that having a fearless attitude and leaning in helped her advance her career:

> Having the self-confidence and having the fearless attitude and just be upfront is extremely useful in my career growth because often times, especially in my younger career, maybe one can be easily intimidated by the situation and I think being more front and center, about your being more straightforward, I guess lean in more is very important in career growth

Patty was working at a startup when it moved to Kansas and she decided to stay in Silicon Valley and take a step back in her career as a software engineer. After six years, she had achieved a Director level in this company. Her leadership journey is a combination of opportunities that became available to working with her manager, taking stretch assignments, and asking for the promotion:

> You know, it seemed like from a career point of view, it seemed like I was taking a step back, but I really believed in the company, which made it easy for me to make that decision that hey, it's ok, this is a temporary setback. I just have to

> work hard and accelerate my career moving forward. So, I've now been at [*my company*] for maybe 6.5 years. Yes, 6.5 years it would be 7 years in May this year, and I went from being a software engineer to becoming an engineering manager, to like becoming a director at [*my company*] and it has been an incredible experience so far.
>
> Once I was an engineering manager, becoming a director was essentially understanding, hey, what are the expectations for, from a manager, how do I get to a senior manager and then a director position. So, some of it was, I would say it's like the transition from manager to senior manager was basically just you know, focusing on my job, making sure I was delivering what was expected of me and the promotion happened. It wasn't as deliberate as my director promotion, but from senior manager to director, I realized that that would have to be, it's not going to happen on its own. Like, for better or for worse, like, I will have to work towards it, I will have to ask for it.
>
> So, the transition from senior manager to director was more deliberate on my part. I sat down with my manager, I was like "hey, I'm doing this work, you have to tell me like, how does this lead to a director position. Tell me exactly what you want to see in order for me to make it to director" and I made sure I held them accountable towards what they were telling me, and I made sure that I delivered everything that they wanted me to deliver on and essentially that's how I got the promotion to director.

Deb's career progression has been mostly on decisions and performance. She believes that identifying what you want to do and having a clear goal is important. Understanding why you want to get to the next level and have clarity on that decision helps to create a career path.

> It's so easy to get there once you know where you want to go sometimes, but sometimes you have to figure out what that is and why that is. Like, you know, I can say sure, like I want to be a CEO. Ok, great, but like, why do want that? What's interesting about it? So, I want to kind of tease that out, or do I want to be a CTO? Like, what is interesting about one versus the other. And I think I'm at this phase where I'm trying to figure out what that is, because why would it be interesting to me. Because if it's not interesting or fun, then there's no point. So, then there's a little bit of self-reflection and kind of answering some questions that I think would be helpful.

Karla was a senior executive who described that many times, she believed she was denied a seat at the table despite her ample experience in the industry. When she described her career advancement, she attributed it to being flexible and being persistent about asking for the next opportunity:

> I developed a thick skin and just tried not to take things personally. And I just figured, if I kept asking, the squeaky wheel gets the grease. And a lot of times, that did help. And sometimes, I just kind of pivoted and set my direction in a different way, and kind of redefined what success meant for me in that specific instance.

Jenny defined adaptability as her career advancement strategy. She leveraged her team's abilities helping them formulate the problem instead of trying to know all the answers.

> It's really important for me to frame the problem carefully, and let other people come up with solutions instead of giving them the right answer. I'd say that that was probably one of the biggest things that I adapted that helped me to continue to move up and be successful.

Patty noted that her advancement reflected a high level of self-confidence and self-awareness, and a willingness to take risks to fix the problems she saw. Like others, she too described that her career advancement required self-advocacy:

> I try to, you know, I try to always think about what is it that I really want to do right now. What is it that I think is the best thing for me to do right now and I went out for that versus worrying about what does that make me look like. Will I be seen as a software engineer if I do this? Or will I be seen as a leader if I do this or not? I concentrated on shifting between roles. I concentrated on doing what it takes.
>
> So, that's one. The second one is this idea of, if I see a problem, I don't want to be a complainer, I want to be part of the solution. So, anytime I saw something that really like turned me off or that I thought was not the right thing, I did something to fix it. That like, trying to act like an owner and trying to go after and fix problems that I saw essentially, eventually started getting noticed. People saw me as a leader because I wasn't waiting for permission. I was just taking things in my own hands and making them better. That helped me quite a bit.
>
> And then the last one was advocating for myself. And this one was like, I think, the first two came naturally to me, that's just who I was, but this last principle of you know, advocating for myself, I would say I'm still learning and struggling with it, but that was the lesson that I took the longest to learn and implement for myself. I realized that I could keep doing the best work possible,

> but if I did not advocate for myself, if I did not like summarize all of that and present it as achievements to people who were making decisions in your career path, career path decisions in the organization, then I wouldn't see the kind of growth that I wanted.

Managing career and life balance. In the literature, career/life balance has been identified as a retention tool and a reason that women in STEM leave their careers. In this study, 50% of the participants did not have children, and this may have limited the career/life balance challenges they faced. From the rest of the participants, only two directly mentioned having to manage career/life. What is notable is that these participants did not pursue an engineering path; the rest of the participants who remained in the engineering path did not share experiences regarding career/life balance as a barrier for career progression. The participants who shared their experiences regarding balancing work and family made choices along the way to prioritize different aspects of their lives.

Mia, who had twins, described that she took a step back for a couple of years after she started a family to balance work and parenting. She made a conscious decision to seek help and focus on areas in her life that kept her motivated and happy.

> I think the number one thing is getting all the help that you can, whether it's through a network of family or the network of commercially available services. The second part is to really, just to make sure you are doing exactly what makes you personally happy, because when I look back and said, "Hey, maybe I'm so concerned about me not spending time with my kids and things like that, but at the end of the day when you are going after doing something to make you happy, being a mom and being an exec at the same time that's really what makes me happy every day, and then that's really what makes everything around you work." So, just figuring out what you like to do and makes you happy is equally important.

Mia also indicated that gaining the full involvement of your spouse was critical to being able to meet work and home responsibilities.

> The next critical piece is getting help from your spouse. My husband is a big part of my network. He has a busy career himself; he's a lead engineer in the semiconductor sector as well, so all of us have a very busy schedule, but having quick communications and figuring out each other's schedule and really have an equal contribution to share the family responsibility is key. I think all of us have to find the right partner to make everything work.

Jenny similarly chose to "take an easier job" when she had an infant and a toddler, recognizing that choices were required to achieve balance in work and family life.

> I think there were various times when I had, I was a director already when I had my second child. And I did a lot of travel. The company went through a lot of change. So, I debated. I was really burned out after having a colic baby and a two-year old. So, I debated going part-time. Instead, took a no travel job for a year. So, I don't know if that was really a career setback. But it was really more of a decision, that I was just going to take a job that was a little bit, had less travel. A little bit less stressful. I guess a little easy to manage, it was a pretty easy job for me for a year and a half.
>
> I have a belief that you can't have it all, but you can't have it all at the same time. Have a good balance. It was a decision to focus on one thing for a while, and put my career on a less, on a slower path. So that I have more time at home.

Trina described different circumstances, but also made a decision to ensure she find more balance in her career:

> My husband was in school, I had a child, so I was the sole support for family, and in a group of 100 engineers, where at the time I was one of two women and became one of four at some point in that time period, there wasn't a lot that could be done that I could see to be able to change it. So, I decided to leave that group and start looking for other positions in a different group.

These women described career decisions that allowed them to balance their family life and their work life, acknowledging the need to consciously create ways to stay in their career while parenting young children. They described their promotion into leadership as drawing on competence to build their self-confidence, having mentors who advised and advocated for them, consciously managing their career path, and maintaining an awareness of career/life balance.

Summary of Findings

The participants described lived experiences growing up sharing their common interest and passion for math. This interest was identified early on by parents and mentors who provided tools and advice to encourage and feed this interest. Their interest and passion were further complemented by a natural ability; they often mentioned that math came easy to them.

Making the choice of studying computer science and engineering differed. Some of them went directly into their major, others transferred from other technical disciplines, others discovered engineering by chance. The majority (7 of 10) continued into technical graduate degrees. Once in their careers, they took different paths to senior leadership positions in Silicon Valley; half of them took a technical path, the others took a non-technical path.

While they all faced social and professional barriers, regardless of their path, they described how they drew on intrinsic strategies to persist and overcome these barriers. Grit, as defined by Duckworth et al. (2007), was central to their success. A second intrinsic persistence strategy was they possessed a high level of confidence in their abilities; this confidence was rooted in their technical competence. Career/life balance was approached differently. Half the participants, while married, chose not have children; of those with children, most described that their spouse was fully involved with sharing family responsibilities. While being the only woman in the team and acknowledging the bias they faced was reported by the participants, surprisingly a commonly known barrier, sexual harassment was indicated by only one participant.

Perseverance and overcoming barriers were complemented by strategies that furthered their career growth. The participants had professional mentors who helped them with advice, support, and advocacy along the way. They managed family and career consciously when needed, making decisions to stay in the workforce, but also to "step back" for a short time into roles that allowed them to successfully do both. In summary, personal characteristics of perseverance and passion for the field kept them from leaving; their career strategies helped them advance.

Results and Interpretation

This final section of Chapter 4 offers an interpretive discussion of the experiences of the participants in the bounded system of Silicon Valley in a contemporary context to answer the central question of this study: Why do women with Computer Science and Engineering degrees in senior leadership positions in Silicon Valley stay in the field?

Observations and results that emerged from this case study are now discussed in relation to the literature review in Chapter 2. These results and corresponding interpretations further inform the conclusion and recommendations offered in Chapter 5. A case study encompassing experiences of 10 women in senior leadership roles in Silicon Valley technology firms offers a limited view, yet important insights into the experiences of women who stay in the leaky pipeline and reach levels of leadership success. The findings from the essence of the experiences of these women may offer insights that can be used to help other women early in their careers stay and move into senior leadership roles.

Result One. Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley had early math aptitude and were actively supported by parents and mentors.

At the start of this research, the focus was to get a general understanding of the professional and social experiences that drove the participants to stay and advance in their careers in Silicon Valley. However, during the interviews, an unexpected theme emerged that contributed to their persistence. This research identified that these 10 participants shared a STEM foundation grounded on two pillars—math ability and supporting environment by parents and mentors to pursue their interests.

Fifty percent of the respondents shared an early interest in math and science. The participants spoke enthusiastically about their early math aptitude and how their parents supported their interests. In a study of persistence in engineering college students, Burtner (2005) found that confidence in math and science combined with the motivation to study engineering reduced attrition. The persistence of these women in the fields of Computer Science and Engineering, with their interest in math, indicates a potential correlation between their math ability and career persistence, supporting Burtner's (2005) findings.

Second, from their childhood, when the participants demonstrated mathematics ability, it was encouraged and nourished by their parents and mentors. Some parents provided early exposure to computers that allowed them to teach themselves how to code and feel comfortable around technology. Mentors guided or recommended to explore an Engineering field. Having parental and mentor support and access to technology aligns with Mazdeh's (2011) case study research of women engineers and the influence of early childhood technologic environment, which previously indicated that providing passive and active exposure to engineering concepts and providing a childhood supportive environment positively impacted their interest in pursuing and persisting in a STEM career. Findings in this research identify a link between interest in Computer Science and Engineering and the influence of parents and mentors. These findings contrast with Ing's (2014) findings, indicating female student achievement in mathematics and science, as well as persistence in STEM careers, is not determined by parental support.

Lastly, in a well-known Engineering Competency Model Tier 2 (Leslie, 2016) described in Appendix J, mathematics is described as using mathematics to express ideas and solve problems. Science and Technology is described as using scientific rules and methods to express ideas and solve problems on paper, on computer, or on adaptive devices. This engineering competency model maps to the STEM pillars identified in the participants' early childhood experiences.

Result Two. Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley described their mostly positive experiences despite facing social and professional barriers in Silicon Valley.

In Chapter 2, the research pointed to several social and professional barriers including lack of mentors, lack of access to informal networks, culture, unconscious bias, career/life balance, and lack of confidence (Frehill, 2012; Preston, 1994; Servon, 2011). These Silicon Valley women leaders reported frequently being the only woman in a male-dominated environment and experiencing unconscious bias from their managers and peers. The participants, however, reported having access to mentors and informal networks, having a high level of confidence, and negotiation of career/life balance through personal choices.

Being the only woman in a team was experienced in both positive and negative ways. On the positive side, having a strong technical background and being the only women provided a recognizable platform. On the negative side, if managers or coworkers expressed unconscious bias, the effects on the participants varied. Bias was perceived as a social barrier by most of the participants; this is in alignment with findings by Simard and Gammal (2012), who found that persistent unconscious biases keep women's representation in technology low.

Their experiences differed based on where they were in their careers, some making intentional choices to combat bias, others simply not recognizing or experiencing bias. Previous research has established that barriers to women in management exist worldwide and that a psychological barrier that associates managers to males can foster bias against women in managerial selection, placement, promotion, and training decisions (Schein, 2001).

Lastly, only one participant reported sexual harassment. This finding is in contrast with the popular narrative about Silicon Valley and published research on women in STEM. Servon and Visser (2011) found that women in the science, engineering, and technology sectors experienced demeaning and predatory behavior in the workplace. It is also the popular belief that women in technology in Silicon Valley face bias and sexual harassment. According to The Elephant in the Valley Survey (Vassallo et al., 2016), of 200 surveyed women by Stanford University, 60% of the participants said they had dealt with unwanted sexual advances from a coworker. In my 27 years in Silicon Valley, I have never experienced sexual harassment, and the contrast of my experience with the reported experiences of women in technology in

Silicon Valley was one of the reasons why I undertook this research. It was interesting to find that nine of 10 women at the senior level similarly did not report being sexually harassed. These findings challenge the work of earlier researchers and narratives that have long reported that women in STEM experience sexual harassment. As recently as 2018, the National Academies of Sciences, Engineering, and Medicine (U.S.) Committee on the Impacts of Sexual Harassment in Academia (2018) found that almost fifty percent undergraduate women in engineering had experienced sexual harassment from faculty or staff.

The lived experiences of the participants in this research reflect a more self-deterministic optimism based on their ability to manage their career and setbacks. They demonstrated behavioral and intentional persistence described by Cech et al. (2011). While many women in STEM choose to leaving engineering for other STEM majors, the participants, in contrast, showed a commitment to work as an engineer. The participants demonstrated professional role confidence, which has been identified as the best predictor of behavioral and intentional persistence (Cech et al., 2011).

Relying on grit and passion for their jobs, many of the participants indicated they stayed in their jobs because they loved what they did. The participants also benefited from the specific high mobility and diverse character of Silicon Valley leveraging professional networks and fluidity of organizational boundaries (Shih, 2006). As described in Chapter 2, I started with some assumptions regarding unconscious bias affecting women in STEM fields being likely caused by environmental factors and assuming that many women in STEM fields have suffered from unique challenges precluding them from persisting and advancing in the field (Glass et al., 2013). A second assumption was that women who are attracted to STEM fields have an intrinsic passion and motivation in the field that helps them manage these barriers and persist in the field, which was shared by the women in the study (Modi et al., 2012). While the experiences and observations from these participants somewhat validated these assumptions, their coping strategies that included professional role confidence and grit to face these barriers allowed them to stay when others left.

Result Three: Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley persisted and advanced their careers using *Grit*.

Blickenstaff (2005) referred to women leaving the STEM field as leading to a leaky pipeline and suggested that women, specifically in science, leave the pipeline at different stages, starting in secondary education, through college, and after graduation by switching careers. Much of the research and narratives of women leaving the technology and STEM fields talk loosely about women working in technology companies regardless of their educational background. Research on women engineers has found that only 60% of women engineer over the age of 30, stay (Preston,1994). Buse (2009) described women engineers' persistence as an effect of self-efficacy. This case study research in the bounded system of Silicon Valley further ventured to capture the experiences of women with Computer Science and Engineering degrees in senior leadership roles who stayed and persisted in their careers. The findings of this research suggest that participants who stay had technical competence supported by self-confidence in combination with perseverance and passion.

Whitney et al.'s (2013) findings on mid-career women in technology suggested that women face professional barriers: (a) lack of mentors, (b) lack of access to male social networks, (c) lack of self-confidence, (d) culture, (e) unconscious bias, and (f) work-life balance. In the current study, eight of the participants spoke of mentoring throughout their youth and career. These findings are in line with the findings of Fouad and Singh (2011) who concluded that women who did have mentors had higher job satisfaction and lower intention to leave the field or the company. Roberts and Ayre (2002) described male networks, which provide promotion and mentoring opportunities; seven of these participants had access to mentors through male social networks and described how they were able to gain access. While a lack of self-confidence is often seen as a cause for women dropping out of the science track (Alper, 1997; Whitney et al., 2013), in their experiences, these women leaders demonstrated a high level of confidence. Lastly, the participants negotiated the challenges of career/life balance making personal choices—some choosing not to have a family, and others leveraging on the active involvement of their spouse.

Summary

This chapter discussed the findings of the study detailing each theme that emerged from an analysis of the data and offered four themes that emerged from the research. Three results of the study were presented and interpreted considering the review of literature presented in Chapter 2. The results suggest there are intrinsic and extrinsic strategies for persistence in the field:

1. Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley had early math aptitude and were actively supported by parents and mentors.

2. Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon described mostly positive experiences despite facing social and professional barriers in Silicon Valley
3. Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley persevered and advanced their careers using *Grit*.

Chapter 5: Conclusions and Recommendations

Introduction

The purpose of this case study was to capture the "voices of women who stayed" to understand the experiences of women in technical or non-technical leadership roles with Computer Science or Engineering degrees that have helped them persist and advance in their careers in the context of Silicon Valley. The leaky pipeline phenomenon was introduced and described as women leaving the Science, Technology, Engineering, and Mathematics (STEM) track at many stages in the pipeline (K-12, secondary, college, career). The leaky pipeline has resulted in the underrepresentation of women at all levels of the STEM career ladder and, specifically, women with Computer Science and Engineering in leadership positions.

Using a case study methodology, this study sought to answer the following research questions:

1. How do women with Computer Science and Engineering degrees who are in senior leadership roles in high-technology companies in the Silicon Valley describe their experiences facing social and professional barriers?
2. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their persistence strategies?
3. How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their career growth strategies and how these strategies support their success?

The lack of women in senior leadership roles in Silicon Valley high-technology companies is a contemporary phenomenon. The experiences learned from the 10 women executive participants illuminate how women in Computer Science and Engineering and other STEM fields may potentially persist and grow in their careers in greater numbers.

Research participants in this case study included women who hold degrees in Computer Science and Engineering and who have served in director, vice president, or executive leadership roles in Silicon Valley. The 10 participants held leadership positions in large, medium, and small high-technology companies. Participants ranged from 30 to 70 years of age, with the average age being 46 years old. Five participants pursued a technical path to senior leadership roles; the other five chose a non-technical path to senior leadership roles. The findings and results of the study emerged from the coding and subsequent analysis of data drawn from verbatim transcriptions of one-on-one interviews, a review of artifacts, and the researcher's observations of the participants during their interviews. This tactic helped clarify the "how and why" strategies of women in leadership roles, the case study methodology was well suited as a research approach. Through analysis of their experiences, the researcher sought to portray examples of persistence and career growth that can be shared with the next generation of women in STEM.

The four themes that emerged from the interviews and artifact reviews and informed the findings were: (a) STEM foundation, (b) grit, (c) Silicon Valley barriers, and (d) career strategies. Three results emerged from the findings: (a) Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley had early math aptitude and were actively supported by parents and mentors; (b) Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in the Silicon Valley acknowledged their experiences facing social and professional barriers in Silicon Valley, but focused on ways they reached beyond them; and (c) Women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley persisted and advanced their careers using *Grit* (evidenced through their persistence and passion)! Conclusions from the study are offered in response to the research questions posed and emerged from the findings and results that emerged from the voices, perceptions, and experiences of the 10 study participants. This final chapter offers recommendations to diversity stakeholders and women pursuing STEM careers.

Conclusions

Drawing from the trail of evidence presented in Chapter 4, the conclusions are provided in the context of responses to the three research questions that guided this study.

Research Question One: How do women with Computer Science and Engineering degrees who are in senior leadership roles in high-technology companies in Silicon Valley describe their experiences facing social and professional barriers?

During the interviews, women in leadership roles in Silicon Valley described the social and professional barriers around frequently being the only woman in this largely male-dominated environment. They described the challenges they faced experiencing bias and the actions they took in negotiating career/life balance. In college, these women were frequently the only one or one of a very small number of women in their Computer Science and Engineering classes. Their experiences continued in Silicon Valley roles when they were frequently the only woman in the work team. In these male-dominated environments, they experienced bias initially coming from their professors in college and later from their managers who had little or no experience managing women.

They faced both intrinsic and extrinsic barriers. Some of their managers directly let them know their opportunities for promotion and advancement were limited, not because of their technical excellence and soft skills, rather because getting to senior leadership roles was about who you knew. When faced with this bias (and many times it was unconscious), these women took action, moving to other positions that would allow them to work for a more supportive manager or seeking out more training. Some took the feedback to heart and held themselves back until they closed the knowledge gaps and built up their confidence.

There is a high expectation in technology companies for long work hours and frequent travel. Half the women, while married, did not have children; the ones who did described how their partners and family stepped in to actively support or used commercially available services, which helped them manage both work and the family responsibilities. Some of the women actively made decisions about family priorities and made career choices when their children were infants and toddlers to take jobs that were a step back, allowing them to succeed in both areas.

Sexual harassment has been at the forefront of the discussions about the experiences of women in technology companies in Silicon Valley. With only one respondent of these 10 women in senior leadership roles having reported sexual harassment, a question is raised as to why these confident women in leadership roles with strong technical backgrounds did not have this experience. These findings were limited to one interview that may have contributed to this conclusion. There is an opportunity to further explore in depth these particular experiences with senior women with Computer Science and Engineering degrees in Silicon Valley.

Women with Computer Science and Engineering backgrounds in technology companies experienced a taxing environment; however, at the same time, they considered that they were in a creative environment where you get to work with very smart people solving big problems, which made their work both fun and rewarding. The study confirmed that there are barriers in technology companies that center around bias toward women and clarified that those who stay developed persistence strategies that helped them advance.

Research Question Two: How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their persistence strategies?

Not one of the 10 women senior leaders considered leaving their careers at any point in time. Findings in this case study research point to intrinsic attitudes and extrinsic factors shared by these women in leadership roles in Silicon Valley. Intrinsically, they all had Computer Science and Engineering degrees, were openly self-confident based on a common STEM foundation, evidenced persistence and passion (grit), and made personal choices to secure mentor support. Extrinsic factors including having parents and mentors in school and careers who encouraged their interest in computers and engineering; and providing nurturing environments may have contributed to their self-confidence and persistence.

The participants in the study described their persistence strategies as a combination of perseverance and passion. They also made intentional choices about their careers and sought and received support from mentors. They faced difficult social and professional barriers from the time they were in college, being one of the few women in their majors, to later in their careers being the only women in the team. They persisted through making personal and professional choices including: (a) not having children, taking a step back, or reducing responsibilities in their careers when they did and (b) moving from a technical track to a non-technical track and understanding their limitations and working towards overcoming them.

They all had a great capacity to overcome these obstacles. At the center of their persistence was their love for the profession that made it fun at the end of the day. They enjoyed working on difficult problems and despite all the obstacles at the end, they had passion in what they did; the women who stayed evidenced grit.

Research Question Three: How do these women with Computer Science and Engineering degrees in senior leadership roles in high-technology companies in Silicon Valley describe their career growth strategies and how these strategies support their success?

Most of the research on the leaky pipeline focuses on women who leave and the actions that technology companies have to take to retain and promote women. These actions include creating diverse teams, building a bias-aware culture, and opening opportunities for women to stay and advance. Other research points to actions women can take to persist and advance. This study confirmed that having self-confidence, leveraging mentors, and making intentional career choices while balancing career/life supports persistence in the field.

Building confidence requires a self-understanding of areas for improvement and taking action, either by continuous study or making career moves. Mentors were identified as a major influence in careers of these women. The women took advantage of the feedback from their mentors to close gaps and make career choices. Women leaders in Silicon Valley who stayed and advanced described their career growth experiences as a combination of overcoming barriers while finding enjoyment in their work. They made changes that included going back to college to secure a specific degree, to switching career paths, to stepping back in their careers for a period of time.

In contrast with existing research, these participants were aware of the barriers and navigated them. While they did not develop similarities with male peers or have strong networks with other women, they did successfully reconcile work and home responsibilities. Some took time off work when they had children, while others took reduced responsibilities including limited travel. Women who stayed identified these barriers and sought ways to navigate them without giving up.

Recommendations

The following recommendations focus on ways to increase the pipeline of women in STEM fields, learn from experiences of women with Engineering and Computer Science backgrounds, and understand their persistence and career growth strategies. Much has been said about how organizations can do to improve the situation of women in technology companies. From providing flexible work schedules, career development opportunities with clear advancement criteria and availability of mentors (Simard et al., 2008). Recommendations offer ideas on ways to enhance the social and professional experiences of women to aid in their career persistence. Finally, there are recommendations on early interventions to increase the interest in early childhood into STEM careers.

Recommendations for Women in Computer Science and Engineering to Reach Leadership Roles

Build your confidence. Computer Science and Engineering require lifelong learning; women in STEM can benefit from building a solid technical foundation in math and science and engineering principles. They can leverage this confidence to overcome intrinsic and extrinsic barriers.

Working in technology companies can be very challenging. Women in this environment will be faced with being the only (or one of a small number of) woman on the team, and they may experience bias and possibly sexual harassment. Three strategies women in technology can take to persist are offered. First, develop self-awareness. Understand what your confidence gaps are, including technical gaps. Read, take classes, and find mentors that will help you build your confidence.

Bias. When faced with being the only woman on the team, have the conversation about your experience with your manager and your peers to broach issues that may be related to bias. In the last few years, there has been a huge emphasis on building diverse teams; you can help build a culture on the team where people can have open discussions about their experiences, and this potentially can help lower the barriers.

Do not give up. Before deciding to leave, evaluate different career paths within the organization. Your career is not a sprint, it is a marathon. You will need to take lateral moves, take time off, or request fewer responsibilities to manage the balance of work and family. Clearly understand the career path is not easy, but you have the ability to make choices, and it is your choices that allow you to reach senior roles.

Find passion in the profession. This case study revealed that passion is important in persistence. As one of the participants mentioned, engineering can be tough medicine, and it is not for everyone; it requires long hours and a high level of commitment. For the foreseeable future, women in high-tech companies will face social and professional barriers, from culture gaps to unconscious bias and keeping a career/life balance. Women who are interested in persisting in their careers can find the areas that are interesting and that will keep them motivated, happy, and having fun with work. It will require time and effort that in the end can help with persistence in the field during the tough times.

Leverage your support system. The scarcity of mentors has been determined to be a significant predictor of success for women in STEM. Persistence and advancement in Computer Science and Engineering are not a hero's journey; women in STEM can further look for opportunities to leverage their mentors as well as networks to stay and advance in their careers. When faced with an unsupportive manager, seek an alternative role that will allow you to use your skills working with a different team and for a more supportive manager. In addition, seek out organizations that provide opportunities for mentorship and sponsorship to support your advancement. Women can partner with companies, managers, and peers on negotiating these barriers.

Recommendations for Parents and Mentors

The early experiences of women leaders point to a solid foundation in STEM, derived from the support of parents and mentors. We cannot underestimate the importance of the interplay between adults and young people. Parents play a critical role in fostering an interest in computers and engineering by what they say, creating access to experiences that foster early talent, and respecting and encouraging their daughters' choices for science. As learned from the experiences in this case study, a single interaction with a teacher that pointed to a STEM direction was long-lived and well-remembered.

Recommendations for future research. This research captured the lived experiences of women with STEM degrees in Silicon Valley. Proponents of retaining and advancing women in STEM have focused on the changes organizations can make, as Simard et al. (2008) recommended in their study on technical women's career advancement. There are further opportunities to learn the intersections of women's grit with the company culture and learning if women leaders experienced sexual harassment and how they negotiated these situations. Lastly, there are opportunities to explore additional dimensions of this problem, further understanding the background of women leaders in STEM, including career stage or how ethnicity plays a role. In regard to early interventions for parents and mentors, future research can include a longitudinal research that ties career interest and, later, perseverance and passion for the profession.

Summary

This chapter underlines and reiterates the purpose of this case study of women who stayed. In this chapter, the conclusions and recommendations were explored based on the key findings of how women in leadership positions in Silicon Valley with Computer Science or Engineering degrees persisted. Moreover, it explained the process of developing and arriving at the study conclusions, recommendations, and suggestions for further research.

The key findings suggest having early interest and ability in STEM helps develop confidence at an early age. Having parents and mentors support this interest and abilities further enhances this STEM foundation. Women with Computer Science and Engineering degrees in high-tech companies in Silicon Valley can rely on their confidence, technical expertise, and mentors to overcome social and professional barriers and advance in their careers.

What emerged from this case study expands the understanding of experiences of women in technology companies. At the heart of persistence, it is necessary to have confidence, perseverance, and passion for the profession, grit. Women continue to be underrepresented in leadership positions in high-tech companies in Silicon Valley. Companies have started understanding their demographics and publishing their diversity numbers; this is a great step. Companies have also started to build more welcoming cultures, bringing awareness to unconscious bias and sexual harassment. There are still opportunities to further build a diverse leadership pipeline. In this case study, only one participant reported sexual harassment, which is in contrast with many reports. Further research opportunities include learning about sexual harassment experienced by senior women in high-tech companies, especially with technical degrees and how to develop grit. The leaky pipeline is a complex problem, and understanding why women leave, as well as why women stay is important. Women need to stay to rise to the top. However, their persistence and career advancement are not a hero's journey; parents and mentors along the way help through the process. It takes a village.

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Appendix A : Example of SV150 2016 (51-100)

51	Linear Technology	**76**	Coherent
52	Fairchild Semiconductor	**77**	Zynga
53	Netgear	**78**	NetSuite
54	Viavi Solutions	**9**	Splunk
55	Polycom	**80**	Integrated Device Tech.
56	Square	**81**	FireEye
57	Finisar	**82**	Ubiquiti Networks
58	Omnivision Technologies	**83**	Yelp
59	Atmel	**84**	Silicon Graphics
60	Pandora Media	**85**	Cepheid
61	Workday	**86**	Extreme Networks
62	Palo Alto Networks	**87**	PMC - Sierra
63	Shutterfly	**88**	Rovi
64	Fortinet	**89**	Intersil
65	ServiceNow	**90**	Quantum
66	LendingClub	**91**	Tivo
67	Dolby Laboratories	**92**	Silver Spring Networks
68	Medivation	**93**	Omnicell
69	Infinera	**94**	Ultra Clean
70	Electronics for Imaging	**95**	Rocket Fuel
71	Impax Laboratories	**96**	Pure Storage
72	Fair Isaac	**97**	InvenSense
73	Align Technology	**98**	Cavium
74	Lumentum Holdings	**99**	Veeva Systems
75	Arista Networks	**100**	Solarcity

Source : (Davis et al., 2016)

Appendix B: Gender Profile of SV150 (Subset) Tech Workers (Global)

	2016		YTD 2020	
Company	**% Male**	**% Female**	**% Male**	**% Female**
Apple (2018)	79	21	64	36
eBay (2019)	76	24	60	40
Facebook (2019)	84	16	63	37
Google (2020)	81	19	68	32
Intel (2019)	80	20	74	26
Oracle (2019)	71	29	69	31
Yahoo (2015)	84	16	n/a	n/a
Average	**79**	**21**	**66**	**34**

Sourced from the following company diversity reports:

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eBay. (2020). *Diversity and inclusion*. Retrieved from https://www.ebayinc.com/company/diversity-inclusion/by-the-numbers/

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Appendix C: Gender Profile of SV150 Executives (1-150)

Compiled from the websites listed in the table (Galván, 2016).

Rank	Company	# Male	# Female	# Females with STEM Degrees	Team % Female	Source
1	Apple	16	3	1	16	http://www.apple.com/uk/pr/bios/
2	Alphabet	5	1	0	20	http://www.reuters.com/finance/stocks/companyOfficers?symbol=GOOG.O
3	Intel	19	4	3	17	https://newsroom.intel.com/biographies/executive-management/
4	Hewlett Packard Enterprise	10	1	0	9	https://www.hpe.com/us/en/leadership.html
5	HP	11	3	0	21	http://www8.hp.com/us/en/hp-information/executive-team/team.html
6	Cisco Systems	11	5	3	31	https://newsroom.cisco.com/exec-bios
7	Oracle	25	5	1	17	https://www.oracle.com/corporate/executives/index.html
8	Gilead Sciences	9	3	1	25	http://investors.gilead.com/phoenix.zhtml?c=69964&p=irol-govmanage
9	Facebook	6	2	1	25	http://www.bloomberg.com/research/stocks/private/people.asp?privcapId=20765463
10	Synnex	6	0	0	0	http://ir.synnex.com/management.cfm
11	Applied Materials	10	1	0	9	http://www.appliedmaterials.com/company/about/leadership/executive-team
12	PayPal Holdings	8	1	0	11	https://investor.paypal-corp.com/directors.cfm
13	eBay	9	4	1	31	https://www.ebayinc.com/our-company/our-leaders/
14	Netflix	8	1	0	11	https://ir.netflix.com/management.cfm
15	Salesforce.com	6	4	1	40	http://www.salesforce.com/company/leadership/executive-team/
16	Vmware	14	3	0	18	http://www.vmware.com/au/company/leadership
17	Sanmina-SCI	5	0	0	0	http://www.sanmina.com/company-profile/management-team/index.php
18	Lam Research	4	0	0	0	http://www.lamresearch.org/Company_1_4.cfm
19	NetApp	10	1	0	9	http://www.netapp.com/us/company/news/executive-bios.aspx
20	SanDisk	10	0	0	0	https://www.sandisk.com/about/company/our-team
21	Symantec	8	3	1	27	https://www.symantec.com/about/corporate-profile/management-team
22	Adobe Systems	7	2	0	22	http://www.adobe.com/about-adobe/leaders.html
23	Nvidia	4	2	1	33	http://nvidianews.nvidia.com/bios/
24	Yahoo	11	5	1	31	https://about.yahoo.com/#leadership
25	Juniper Networks	8	1	0	11	http://www.juniper.net/us/en/company/leadership/#tab=dtabs-1
26	Intuit	9	6	0	40	http://www.intuit.com/company/executives/
27	Electronic Arts	9	3	0	25	http://www.ea.com/executives
28	Tesla Motors	3	0	0	0	http://ir.tesla.com/management.cfm
29	Agilent Technologies	11	3	1	21	http://ir.tesla.com/management.cfm

Rank	Company	# Male	# Female	# Females with STEM Degrees	Team % Female	Source
30	Advanced Micro Devices	7	2	1?	22	http://www.amd.com/en-us/who-we-are/corporate-information/leadership/
31	Varian Medical Systems	5	4	0	44	https://www.varian.com/about-varian/leadership-and-governance/executives-menu
32	LinkedIn	5	2	0	29	https://press.linkedin.com/about-linkedin/management
33	KLA-Tencor	3	0	0	0	http://www.kla-tencor.com/Company/management-team.html
34	Equinix	13	3	0	19	http://investor.equinix.com/phoenix.zhtml?c=122662&p=irol-govboard
35	Intuitive Surgical	15	4	2	21	http://intuitivesurgical.com/company/leadership/exec_staff.html
36	Trimble Navigation	19	4	1	17	http://www.trimble.com/Corporate/About_Executives.aspx
37	Synopsys	13	2	1	13	http://www.synopsys.com/Company/AboutSynopsys/Pages/ExecutiveManagement.aspx
38	Brocade Communications	11	3	1	21	http://www.brocade.com/en/about-us/leadership.html
39	Maxim Integrated Products	9	0	0	0	https://www.maximintegrated.com/en/aboutus/leadership.html
40	Twitter	5	2	0	29	https://about.twitter.com/company/press/leadership
41	Xilinx	9	1	0	10	http://www.xilinx.com/about/management-team.html
42	Super Micro Computer	4	1	0	20	http://ir.supermicro.com/management.cfm
43	VeriFone Systems	12	2	1	14	http://ir.verifone.com/OD
44	Bio-Rad Laboratories	7	2	1	22	http://www.bio-rad.com/en-us/corporate/corporate-officers
45	Synaptics	10	2	1	17	http://www.synaptics.com/leadership
46	Fitbit	7	0	0	0	https://investor.fitbit.com/governance/management-board-of-directors/default.aspx
47	Cadence Design Systems	10	1	0	9	https://www.cadence.com/content/cadence-www/global/en_US/home/company/executive-team.html
48	GoPro	12	1	0	8	http://investor.gopro.com/management.cfm
49	Cypress Semiconductor	13	0	0	0	http://www.cypress.com/management
50	SunPower	10	1	0	9	https://us.sunpower.com/company/leadership-team/
51	Linear Technology	14	0	0	0	http://quotes.wsj.com/LLTC/company-people
52	Fairchild Semiconductor	5	0	0	0	https://www.fairchildsemi.com/about/leadership/
53	Netgear	5	2	0	29	https://www.netgear.com/about/management/?cid=wmt_netgear_organic
54	Viavi Solutions	7	1	1	13	http://www.viavisolutions.com/en-us/corporate/about-us/leadership
55	Polycom	11	2	0	15	http://www.polycom.com/company/leadership.html
56	Square	7	4	1	36	https://squareup.com/about
57	Finisar	7	2	1	22	https://www.finisar.com/company/leadership
58	Omnivision Technologies	9	0	0	0	http://www.ovt.com/aboutus/mgtteam.php
59	Atmel	11	1	0	8	http://ir.atmel.com/management.cfm
60	Pandora Media	7	2	0	22	http://investor.pandora.com/phoenix.zhtml?c=227956&p=irol-govManage

Rank	Company	# Male	# Female	# Females with STEM Degrees	Team % Female	Source
61	Workday	10	4	1	29	http://www.workday.com/company/about_workday/leadership.php
62	Palo Alto Networks	12	1	0	8	https://www.paloaltonetworks.com/company/management-team
63	Shutterfly	7	1	0	13	https://www.shutterflyinc.com/leadership.html?l=0
64	Fortinet	7	2	0	22	https://www.fortinet.com/corporate/about-us/executive-management.html
65	ServiceNow	9	2	0	18	http://www.servicenow.com/company/executive-team.html
66	LendingClub	6	2	0	25	https://www.lendingclub.com/public/company-leadership.action
67	Dolby Laboratories	11	0	0	0	http://www.dolby.com/us/en/about/leadership/senior-management-officers.html
68	Medivation	4	3	1	43	http://www.medivation.com/about_us/management-team
69	Infinera	12	1	0	8	https://www.infinera.com/company/management/
70	Electronics for Imaging	13	5	1	28	http://www.efi.com/about-efi/leadership/leadership-team/
71	Impax Laboratories	10	2	0	17	http://www.impaxlabs.com/our_company/leadership
72	Fair Isaac	7	0	0	0	http://www.fico.com/en/about-us/management
73	Align Technology	9	1	0	10	http://investor.aligntech.com/management.cfm
74	Lumentum Holdings	9	2	0	18	http://investor.aligntech.com/management.cfm
75	Arista Networks	6	2	1	25	https://www.arista.com/en/company/management-team
76	Coherent	6	0	0	0	https://www.coherent.com/Company/index.cfm?fuseaction=Forms.page&PageID=21
77	Zynga	13	4	1	24	https://www.zynga.com/about/leadership-team/zynga-leadership-team
78	NetSuite	9	2	0	18	http://www.netsuite.com/portal/company/management.shtml
9	Splunk	9	2	2	18	https://www.linkedin.com/in/sstledger
80	Integrated Device Tech.	8	1	0	11	https://www.idt.com/about/executive-team
81	FireEye	10	4	0	29	https://www.fireeye.com/company/leadership.html
82	Ubiquiti Networks	3	0	0	0	http://ir.ubnt.com/management.cfm
83	Yelp	16	7	0	30	http://www.yelp.com/management
84	Silicon Graphics	6	1	0	14	https://www.sgi.com/company_info/execbios/
85	Cepheid	9	0	0	0	http://www.cepheid.com/en/about-us-uk/management-team/executive-team
86	Extreme Networks	6	1	0	14	http://www.extremenetworks.com/company/team/
87	PMC - Sierra	10	1	0	9	http://investor.pmc-sierra.com/phoenix.zhtml?c=74533&p=irol-executiveManage
88	Rovi	7	1	0	13	http://www.rovicorp.com/company/management-team.html
89	Intersil	8	0	0	0	http://www.intersil.com/en/about-intersil/management.html
90	Quantum	8	0	0	0	http://www.quantum.com/aboutus/corporateprofile/executivebiographies/index.aspx
91	Tivo	6	1	0	14	http://investor.tivo.com/phoenix.zhtml?c=106292&p=irol-govManage

Rank	Company	# Male	# Female	# Females with STEM Degrees	Team % Female	Source
92	Silver Spring Networks	8	1	0	11	http://www.silverspringnet.com/about-us/
93	Omnicell	7	0	0	0	http://www.omnicell.com/About_Omnicell/Management_Team.aspx
94	Ultra Clean	5	2	0	29	https://www.uct.com/about-uct/leadership/default.aspx
95	Rocket Fuel	9	3	0	25	http://rocketfuel.com/about-us/leadership/
96	Pure Storage	10	0	0	0	https://www.purestorage.com/company/leadership.html
97	InvenSense	8	0	0	0	https://www.invensense.com/management/
98	Cavium	7	0	0	0	http://www.cavium.com/Team.html
99	Veeva Systems	13	3	1	19	https://www.veeva.com/leadership/?type=management
100	Solarcity	12	0	0	0	http://www.solarcity.com/company/team
101	Accuray	5	3	1	38	http://investors.accuray.com/phoenix.zhtml?c=177244&p=irol-govmanage
102	Guidewire Software	12	1	1	8	http://ir.guidewire.com/phoenix.zhtml?c=248177&p=irol-govmanage
103	Five Prime Therapeutics	7	1	0	13	http://www.fiveprime.com/company/management
104	Harmonic	9	0	0	0	http://harmonicinc.com/management
105	Natus Medical	5	0	0	0	http://investor.natus.com/management-team
106	Ruckus Wireless	4	2	1	33	https://www.ruckuswireless.com/company/management/selina-lo
107	ShoreTel	10	2	1	17	https://www.shoretel.com/leadership
108	Affymetrix	7	4	2	36	http://investor.affymetrix.com/phoenix.zhtml?c=116408&p=irol-govmanage
109	Infoblox	9	1	0	10	https://www.infoblox.com/company/overview/leadership
110	Oclaro	7	1	0	13	http://www.oclaro.com/about-oclaro/management-team/
111	Power Integrations	9	0	0	0	http://investors.power.com/investors/corporate-governance/management-team/default.aspx
112	Depomed	8	0	0	0	http://www.depomed.com/about/management
113	NeoPhotonics	8	0	0	0	https://www.neophotonics.com/officers-and-directors/
114	WageWorks	7	4	0	36	https://www.wageworks.com/about/leadership
115	Monolithic Power Sys.	3	1	0	25	http://ir.monolithicpower.com/management.cfm
116	Nimble Storage	9	3	1	25	https://www.nimblestorage.com/company/leadership-team/
117	IXYS	5	1	0	17	http://www.ixys.com/corporate/management.aspx
118	Aviat Networks	8	1	0	11	http://newsroom.aviatnetworks.com/index.php?s=20307#.V4lQY-YrJo4
119	Barracuda Networks	12	2	1	14	https://www.barracuda.com/company/management
120	Sunrun	5	2	0	29	https://www.sunrun.com/about/our-team
121	Box	13	2	0	13	https://www2.box.com/about-us/leadership
122	Chegg	6	1	0	14	http://investor.chegg.com/corporate-governance/management/default.aspx
123	Rambus	11	1	1	8	https://www.rambus.com/leadership/
124	Ring Central	10	1	1	9	http://www.ringcentral.com/whyringcentral/leadership.html

Rank	Company	# Male	# Female	# Females with STEM Degrees	Team % Female	Source
125	Genomic Health	8	4	1	33	http://www.genomichealth.com/en-US/who_we_are/leadership
126	Quinstreet	3	1	1	25	http://investor.quinstreet.com/management.cfm
127	Formfactor	7	1	1	13	http://www.formfactor.com/company/leadership/
128	Tessera Technologies	11	0	0	0	http://www.tessera.com/Company/Leadership.aspx
129	Proofpoint	12	3	0	20	https://www.proofpoint.com/us/why-proofpoint/about-us/our-leadership-team
130	Zeltiq Aesthetics	7	0	0	0	http://investor.coolsculpting.com/management.cfm
131	ServiceSource	5	1	0	17	http://www.servicesource.com/about-us/leadership
132	GluMobile	9	1	0	10	http://www.glu.com/about
133	Inphi	12	1	0	8	https://www.inphi.com/investor-relations/leadership/management.php
134	Quotient Technology	8	2	0	20	http://investors.quotient.com/investors/governance/management-team/default.aspx
135	Imperva	8	2	1	20	http://www.imperva.com/Company/Leadership
136	Nektar Therapeutics	13	5	3	28	http://www.nektar.com/nektar/management.html
137	Sigma Designs	6	0	0	0	http://www.sigmadesigns.com/leadership/
138	Leapfrog Enterprises	6	0	0	0	http://www.leapfroginvestor.com/phoenix.zhtml?c=131670&p=irol-govmanage
139	Gigamon	9	0	0	0	https://www.gigamon.com/company/management
140	Abaxis	6	0	0	0	https://www.abaxis.com/page/executive-management-board-of-directors
141	Marketo	10	3	0	23	https://www.marketo.com/company/leadership/
142	Zendesk	11	3	0	21	https://www.zendesk.com/company/management-team/
143	A10 Networks	11	2	0	15	https://www.a10networks.com/company/management
144	Jive Software	6	3	0	33	https://www.jivesoftware.com/about-jive/management/
145	8x8	8	1	0	11	https://www.8x8.com/about-us/management
146	Natera	15	1	0	6	http://www.natera.com/the-people
147	Nanometrics	7	1	0	13	http://investor.nanometrics.com/management.cfm
148	Penumbra	6	1	0	14	http://www.penumbrainc.com/about/management-team
149	Fibrogen	13	1	0	7	http://www.fibrogen.com/leadership
150	TubeMogul	10	1	0	9	https://www.tubemogul.com/leadership/

Appendix D: Interview Protocol

- Prior to beginning the interview, thank the participant for participating
- Remind them of the length of the interview: 45-75 minutes
- Inform the participant that the interview will be recorded using an audio recording device and video recording device.
- Mention that pseudonyms will be used
- Remind the participant that their participation is completely voluntary and they may stop the interview at any time.
- Ask the participant to sign the consent form.

INTERVIEW – QUESTIONS

1. What are your name, age and marital status? Please describe your family.
2. What were your degrees, where did you get them, and what were your graduation dates?
3. What are your current company, position, and responsibilities?
4. (Lived Experiences) Why did you pursue a career in computer science or engineering?
5. (Lived Experiences) Tell me all about your career in Silicon Valley high tech companies.
6. (Barriers/Persistence) Describe the main professional barriers in your career. Share any barriers that affected your advancement and how you overcome them if any?
7. (Barriers/Persistence) Describe the main social barriers in your career. Share any that affected your advancement and how you overcome them if they existed?
8. (Leadership Strategies) Describe three of your leadership skills that have helped your career and your career advancement.
9. (Specific Skills in CS&E, Persistence) What specific recommendations do you have for women in CS&E to persist in their careers and advance into leadership roles? What ideas do you wish someone had told you?
10. (Persistence) Why did you stay in your career?
11. (Persistence) How do you expect to continue building your career?
12. Please share any additional comments
13. Descriptive notes (i.e. demeanor, office surroundings (if there), sense of presence, communication styles)
14. Reflective notes

Appendix E: Invitation to Participate

Dear __________,

My name is Claudia Galván, I am a Doctoral student in the School of Education at Drexel University Sacramento. This study is being conducted as part of the dissertation requirement for my Doctoral Degree under the supervision of Dr. Kathy Geller, Principal Investigator and dissertation Supervising Professor at Drexel University.

I am writing to invite you to participate in a research study on success strategies of women leaders with compter science or engineering degrees in high-tech companies in Silicon Valley.

The title of my study is "Voices from Women Who Stayed:
A Case Study of Women Leaders with computer science and engineering degrees in High Tech Companies in Silicon Valley in 2016." The purpose of this research is to understand the persistence and leadership strategies used by women with STEM degrees to achieve leadership positions in high tech companies in Silicon Valley.

To be eligible to participate in this study you need to:

1) Have obtained a Bachelor or Master degree in a STEM field
2) Hold a position of director, vice president or executive team member in the SV150 company list as published by the San Jose Mercury News.
3) Have been in this position for at least two years.

Participation in the study would require a single, one-to-one 45 to 75 min interview at a time and place of your convenience. In addition, the study will also need to review artifacts that relate to your background and public engagements. Artifacts may include public data on the internet regarding your public professional engagements.

Please note that participation in this study is completely voluntary and that participants can remain anonymous if preferred. There are no perceived risks involved with this study.

If you have questions, I would be happy to talk in more detail. I can be reached at 408.858.9010 or cg569@drexel.edu. You may also contact the Principal Investigator: Dr. Kathy Geller, 916.273.2790 or kdg39@drexel.edu

Thank you for your time.
Sincerely,

Claudia Galván

Appendix F: Consent Form

Drexel University
Consent to Take Part in a Research Study

A Scripted Process to Obtain Verbal Consent from Interview Participants

1. Title of research study:

Voices from Women Who Stayed:
A Case Study of Women Leaders with computer science and engineering degrees in High Tech Companies in Silicon Valley in 2016

2. Researchers:

Dr. Kathy Geller, Principal Investigator
Claudia Galván, Doctoral Student Drexel University, Co-Investigator

3. Why you are being invited to take part in a research study

We invite you to participate in a research study because you are a leader in Silicon Valley 150 company list with a computer science or engineering degree.

4. What you should know about a research study

- The research study will be explained to you.
- Your participation is voluntary; therefore, you may choose whether or not to participate.
- If you choose to participate, you may withdraw from the study at any time.
- If you decide to not be a part of this research no one will hold it against you.
- Feel free to ask all the questions you want before you decide.

5. Who can you talk to about this research study?

If you have questions, concerns, or complaints, or think the research has hurt you, contact the Principal Investigator Dr. Kathy Geller at kdg39@drexel.edu. This research has been reviewed and approved by an Institutional Review Board (IRB). An IRB reviews research projects so that steps are taken to protect the rights and welfare of humans subjects taking part in the research. You may talk to them at (215) 255-7857 or email HRPP@drexel.edu for any of the following:

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

502 form to be continued. . .

Appendix G: Participant Summary

Participant/pseudonym	Question	Themes	Notes

Appendix H: Artifact Review Protocol

Page ___ of ____
NOTES:

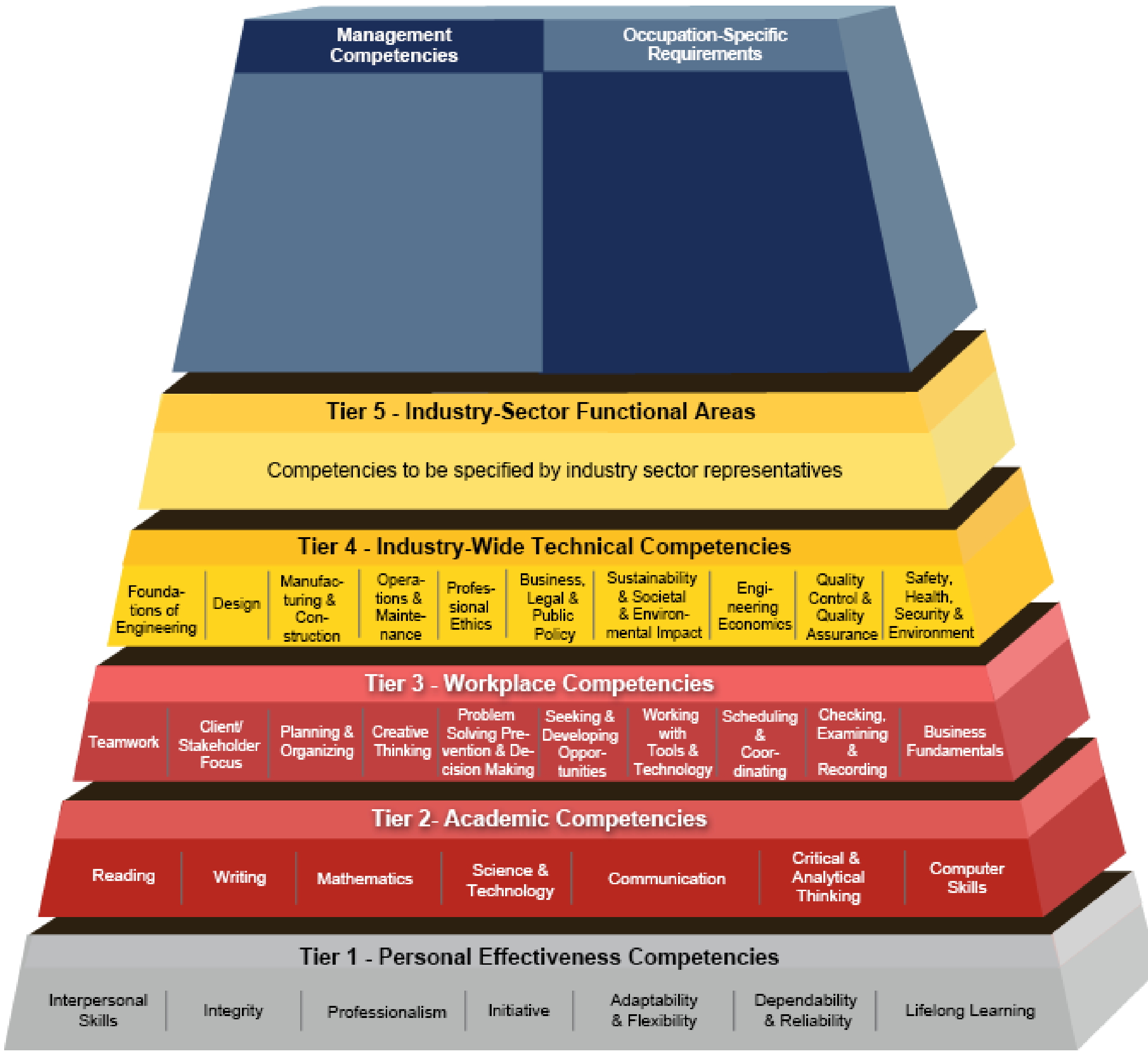
Title/Description:	
Relates:	
Format:	
Review Date:	
File Name:	

Researcher's Reflections:

Appendix I: Artifact Summary

Participant/pseudonym	Artifact	Theme	Notes

Appendix J: Engineering Competency Model



(Leslie, 2016): https://peer.asee.org/engineering-competency-model