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Women Leaders in STEM: A Case Study of Naval Surface Warfare Center

Corona Division

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Women Leaders in STEM: A Case Study of Naval Surface Warfare Center

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ABSTRACT

Over the past several decades, there has been an increasing workforce demand for talent in the science, technology, engineering, and mathematics (STEM) career fields. Although women make up 27% of the STEM workforce in the United States, they make up 25% of the STEM workforce at Naval Surface Warfare Center Corona Division, and just over 5% of these women reach the level of becoming a high-grade senior-level employee. Through the lens of self-determination theory (SDT) and self-efficacy theory (SET), this research sought to understand how high-grade women STEM professionals have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts, if any, can be attributed to organizational culture. A qualitative phenomenological case study was conducted using open-ended interviews with eight women high-grade STEM professionals to gain insight into their lived experiences and assist the researcher in identifying intrinsic and extrinsic sources of motivation within SDT and the impact of SET on the participant's lived experiences. This study revealed the impact exclusion biases could have on career growth and inclusivity within an organization, the effectiveness of passive enablers and the impact of formal champions and mentors, and the need to focus on a healthy work–life balance when evaluating the impact organizational climate and extrinsic motivation factors have on the retention of women in the STEM career fields. The study further revealed the intrinsic and extrinsic sources of motivation that encourage women in the STEM career fields to remain in their profession, including the level of enjoyment while working in a STEM career field, how feeling valued and respected also provides purpose, and how having a manageable work–life balance impacts retention. The recommendations based on the findings from this study are insightful for public

sector organizations and leaders at all levels to understand how to retain and motivate STEM professionals regardless of gender identification.

Keywords: STEM, Women in STEM, motivation, organizational culture, self-determination theory, self-efficacy theory

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DEDICATION

This dissertation is dedicated to my maternal grandmother, Lucy M. Ramos Milian. She devoted her career to introducing future STEM professionals within the Puerto Rico Department of Education to the world of science as children in Caguas, Puerto Rico.

It is also dedicated to the current and future women pursuing STEM degrees and careers. To the women high-grade STEM professionals who participated in this study, thank you for being the first to lead and represent women at Corona Division in multiple technical areas and leadership positions. You are trailblazers for the Command and role models for the current and future generations of STEM professionals and high-grades, regardless of gender identification. To my nieces and nephews who have shared their triumphs and defeats while pursuing their education, degrees, and careers in STEM, thank you for being the silent personal inspirations for this research study.

"God has given you a gift from his great variety of spiritual gifts. Use them well to serve one another"

—1 Peter 4:10

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CHAPTER 1: INTRODUCTION

Over the past several decades, there has been an increasing workforce demand for talent in the science, technology, engineering, and mathematics (STEM) career fields. Even with this demand, a 2012 study by the President's Council of Advisors on Science and Technology (2012) under the Obama Administration found that fewer than 40% of students who enter college intending to major in a STEM career field complete college with a STEM degree. That same study also found that women and minorities, who constituted about 70% of college students at the time, earned only 45% of STEM degrees. Most recently, the U.S. Census stated that women made up 27% of STEM workers and 48% of the total workforce in the United States (Martinez & Christnacht, 2021).

With this ongoing talent demand, there has also been an increased focus on bridging the gender gap between men and women pursuing and working in STEM careers. The U.S. Navy has been part of this pursuit of bridging the gender gap and increasing opportunities for STEM students while reducing the STEM leaking pipeline of students and professionals in the workforce (Office of Naval Research, n.d.). Although women make up 27% of the STEM workforce in the United States, they make up 25% of the STEM workforce at Naval Surface Warfare Center Corona Division (Corona Division), and just over 5% of these women reach the level of becoming a high-grade employee. Based on this data, Corona Division is just 2% lower than the national percentage of women working in a STEM career field. This is significant because it appears that Corona Division is keeping pace with the national average. The findings from this study may help to inform other federal agencies, the larger U.S. Navy, and Department of Defense in sustaining their STEM talent.

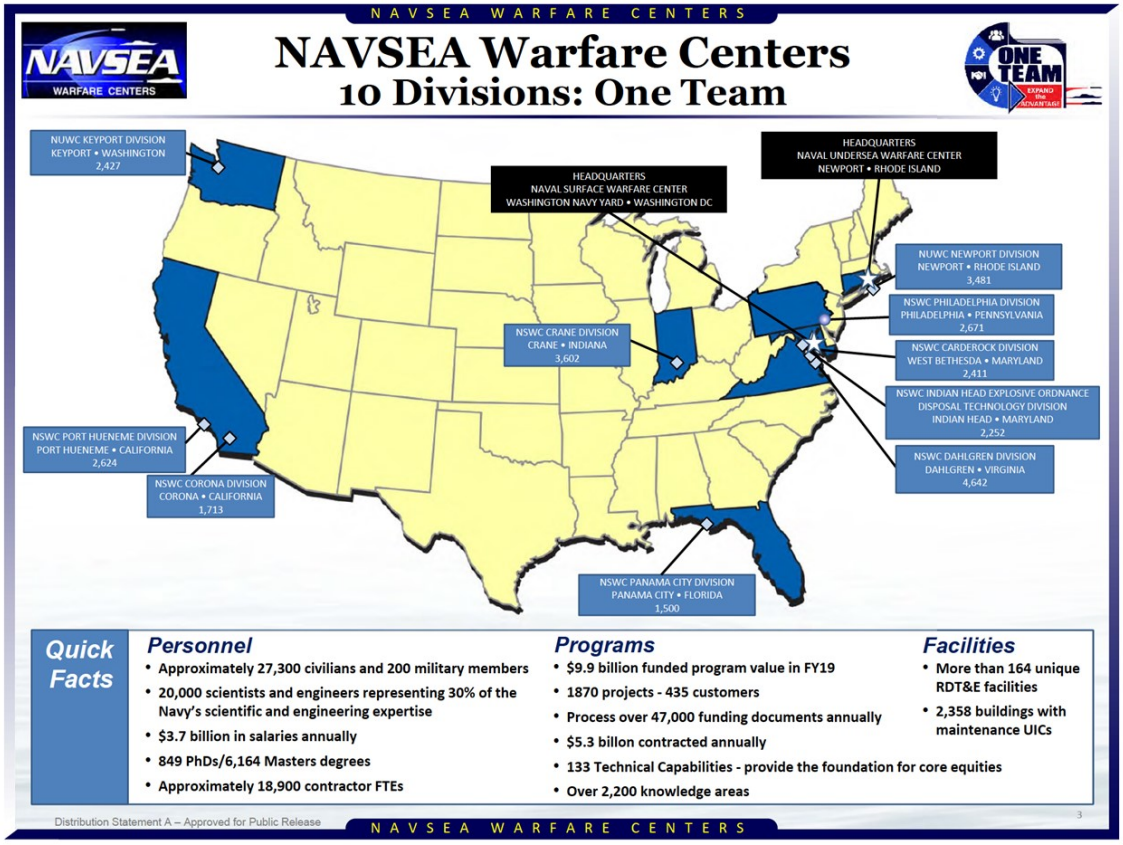
Background

Throughout the researcher's career, he has worked with and been a part of teams that embraced diversity and also lacked diversity. He has gained valuable experience working in both; however, research has shown that diverse groups based on gender, background, professions, and so forth perform better (Credit Suisse Research Institute, 2019; Dixon-Fyle et al., 2020; McMillan, 2010). Some of the most impactful leaders and role models he has had have been women. These women were trailblazers and removed Berheide's "sticky floor" and "glass ceiling" stereotypes (Women in Power, 2021). Numerous dissertations and studies (Alden, 1974; Dixit, 2016; Gandhi, 2009; Heilbronner, 2009; Jenkins, 2008; Norrbom, 2019; Ware, 2019; Whelan, 2017) have analyzed and assessed the challenges women face in the public, private, academic, and military sectors through various methods. This research focused on providing leadership insight from senior-level women in STEM career fields and the unique leadership and development experience women in STEM and management (STEM+M) career fields have had within Corona Division.

Corona Division is one of 10 NAVSEA Warfare Centers. Figure 1 provides an overview of the locations of each of the NAVSEA Warfare Centers and the impact these divisions have on the Navy and the nation. Corona Division serves as the Navy's only independent analysis and assessment center with a workforce of more than 3,200 Sailors, civilian professionals in the STEM and business career fields, and contractors (Naval Sea Systems Command, n.d.-c.).

Figure 1

Naval Surface and Undersea Warfare Centers



Note. From "Naval Surface and Undersea Warfare Centers," by D. Mortimore, 2021, Naval Postgraduate School, p. 1 (https://nps.edu/web/slamr/-/naval-surface-and-undersea-warfare-centers).

According to Naval Sea Systems Command (n.d.-c.), Corona Division's mission is to

> serve warfighters and program managers as the Navy's independent assessment agent throughout systems' lifecycles by gauging the Navy's warfighting capability of weapons and integrated combat systems, from unit to force level,

> through assessment of those systems' performance, readiness, quality, supportability, and the adequacy of training. (para. 5)

Corona Division comprises four technical and three business departments that are each responsible for supporting this mission for the Navy and the Nation.

Along with the increased demand for STEM professionals, organizations can succeed or fail based on their organizational culture. As Lu (2010) found, there is a strong correlation between the need for a flexible and adaptive organization culture, often found within a learning organization, and leaders who can help their organizations adapt and potentially anticipate shifts in their environments, which are essential to instituting organizational changes that are necessary for success. Organizational readiness and capabilities are often identified in the federal government by congressional funding levels and national priorities; however, the researcher argues that organization readiness in delivering solutions to complex global STEM-centered problems depends on individual and team self-efficacy as well as inclusion and diversity of thought. Within highly technical organizations, such as the Department of Defense (DoD) federal laboratories, STEM professionals can be challenged when transitioning from performing primarily technical skills to supervisory and leadership positions. How can organizations create an environment and culture that fosters diversity of thought and experiences that enhance the retention of women STEM professionals? Does organization culture impact the retention of Corona Division women STEM professionals? These are the questions the researcher seeks to understand.

Evolution of Interest

For over 27 years, the researcher has been a member of the U.S. military in a civilian or military capacity. As a logistician in the U.S. Army, the researcher had first-hand experience with military leadership and military organizations with technical and combat skills in Field Artillery, Air Defense Artillery, Combat Service Support, Signal, Engineering, and Military Training Commands. This diversity of organizations and functions exposed him to various leadership styles and experiences, which shaped his leadership development. After over a decade of military service as a soldier, the researcher transitioned to the civil service to support the Army and began his more than 15 years of current civil service. The majority of that experience has been with engineering-specific organizations, which have shaped the researcher's interest in this topic.

As the Chief of Operations for the U.S. Army Corps of Engineers, Los Angeles District, the researcher was responsible for overseeing and managing multiple civil works flood control projects and structures across the tri-state area of California, Arizona, and Nevada. In this position, he directed and managed several multidisciplined engineering organizations and functions, which gave him unique insight into the challenges engineers and others have in transitioning into supervisory positions or leadership positions with greater responsibility. In addition to his leadership role in the organization, he also served as the cofacilitator for the organization's leadership development program, which provided an opportunity for him to mentor and coach future STEM and business leaders throughout the organization and also experience and observe some of the leadership challenges presented to them as they transitioned into supervisory and leadership roles of

greater responsibility. Some high performers continued to perform at a high level. In contrast, others experienced a drop in organizational performance and personal leadership ability that they either recovered from or failed to overcome. Although unknown, the leader's level of self-efficacy in these new positions may have had an impact.

This observation continued when the researcher transitioned from the U.S. Army Corps of Engineers to the NAVSEA Warfare Centers. As the Business Director and Corporate Operations Department Head for the STEM-focused laboratory, the type of organizations managed changed. However, they still included a multidisciplined group of STEM+M employees and business professionals. According to the U.S. Bureau of Labor Statistics (2020), "employment in computer and information technology occupations is projected to grow 11% from 2019 to 2029, much faster than the average for all occupations" (para. 1). Understanding this continued demand for STEM employees and organizations, the researcher was interested in exploring what strategies, skills, and behaviors have been developed and are demonstrated by successful civilian leaders within a military federal laboratory test and evaluation (T&E) environment, specifically women STEM leaders. This exploration can be insightful for the organization and its leaders as both prepare for the next generation of leaders and complex problems that public administrators and leaders will need to maneuver through.

Statement of the Research Problem

Regardless of gender, the demand for STEM+M capabilities and the need for STEM+M employees is not new in the private or public sectors. A decade ago, the National Academies of Sciences, Engineering, and Medicine (2012) identified that the DoD workforce competence in STEM+M was needed to keep pace with the performance,

reliability, and survivability demands on networks, which form the basis of a coherent military force. A recent study from the U.S. Government Accountability Office (2021) identified that "the Strategic Human Capital Management high-risk area declined from a met rating in 2019 to a partially met rating in 2021 for the leadership commitment criterion" (p. 31). This decline was primarily due to identifying skills gaps, which contributed to 22 of the 35 high-risk areas identified in the study and included insufficient staff, inadequate workforce planning, and a lack of training in critical skills (U.S. Government Accountability Office, 2021). Although there is a focus DoD-wide to infuse STEM capabilities within organizations over the next decade, there is also a growing focus on ensuring the relational and leadership skills needed to lead the next generation are not sacrificed for technical competency. As observed by Laursen et al. (2015), "A STEM workforce that does not match the nation's demographics means we are not discovering and developing all the available scientific talent that can help to solve important global problems" (p. 17). Women are highly underrepresented in the STEM career fields. Increasing their representation through retention of women in STEM, specifically women in STEM within the federal government, can enhance the United States' competitiveness on the global scale (Fouad & Singh, 2011).

Purpose Statement

This study sought to understand how women STEM professionals have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts, if any, can be attributed to organizational culture. Understanding the strategies, skills, and behaviors developed and demonstrated by successful women STEM leaders within a military federal laboratory T&E organization

can be insightful for the organization and its leaders. Lavigna (2013) stated that in an environment where civil servants are being "asked to do more with less, then asked to do even more with even less, and ultimately asked to do everything with nothing" (p. 37), there will be an ongoing demand for women in government, and organizational culture may be the game-changer in being able to succeed regardless of political environments.

Research Questions

Research questions assist in focusing a qualitative study's purpose on a specific issue or problem. The importance of framing the research questions in this way is so that they can help to narrow down a broad topic of interest into a specific area of study (Creswell, 2014a). This qualitative study sought to understand the following research questions:

1. In what ways has Corona Division's organizational climate influenced the retention of women in the STEM career fields?
2. What motivates women in the STEM career fields to stay in their profession?

The research variables were each woman STEM professional's lived experiences, which were coded for common themes once qualitative interviews were completed. These common themes assisted the researcher in answering the two research questions in this study. The research questions further impact the study factors, such as the research methodology, sample size, data collection, and data analysis process (Lipowski, 2008).

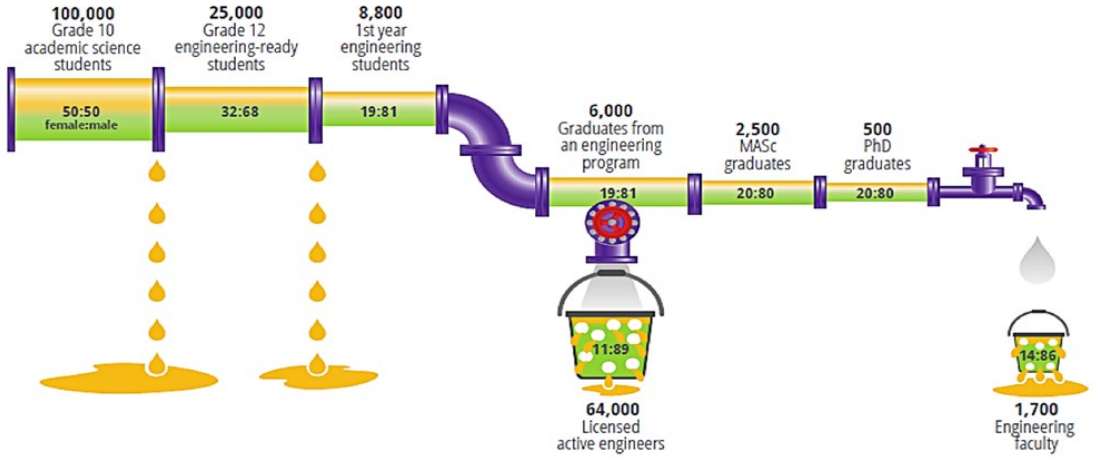
Significance of the Problem

The issue of increasing the number of women pursuing STEM degrees and working in the STEM field is not a new one; however, even with the continued focus to stop the leaking pipeline as represented in Figure 2, retention of women in STEM

continues to be a struggle for public and private organizations. Gender stereotypes, male-dominated cultures, lack of women role models, and lack of individual confidence have been identified as some of the major factors negatively impacting women pursuing and working in STEM fields (American Association of University Women, 2021).

Figure 2

Closing the Engineering Gender Gap Leaking Pipeline



Note. From "Closing the Engineering Gender Gap," by M. A. Wells, 2018, *Design Engineering*, p. 2 (https://www.design-engineering.com/features/engineering-gender-gap/).

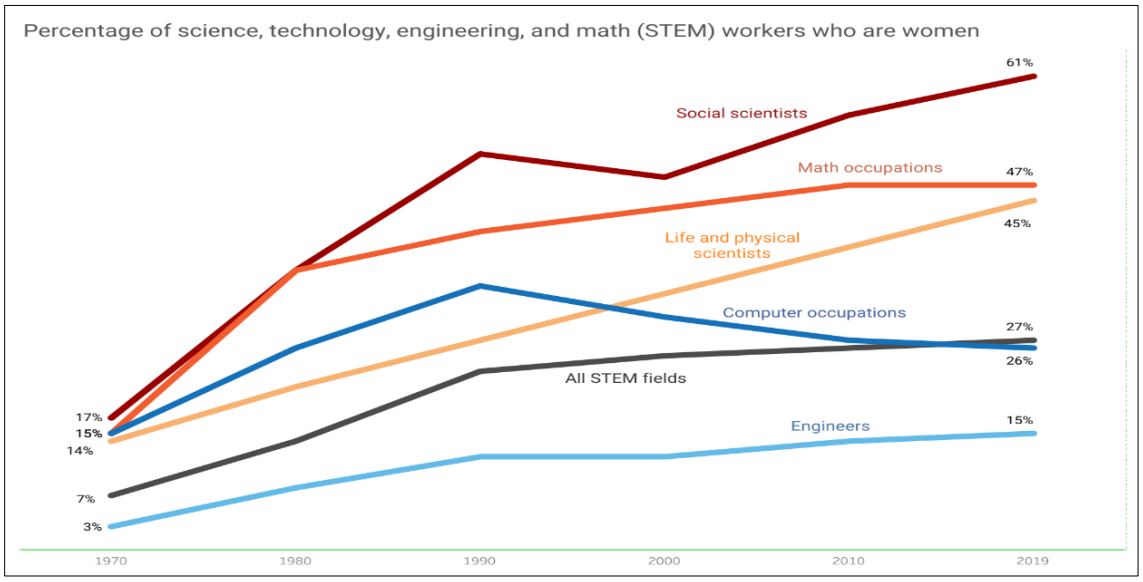
A study on women engineering retention composed of over 3,700 women engineering graduates from 30 universities in the United States found that workplace climate was the most substantial factor in their decision not to pursue or work in an engineering career after college (Fouad & Singh, 2011). Based on the study, 15% of the women decided not to pursue an engineering career, and one in five women chose to leave the engineering career field once they entered it. Of those women who entered the

engineering career field, workplace culture was the most significant determining factor in their decision to leave or stay in their engineering profession. With an ever-increasing demand for organizations to innovate and evolve to meet the current and future challenges of the world (Morgan, 2006), workplace culture and a focus on human capital, including women in STEM fields, may be the difference between organizational success or failure. Regardless of organizational structure or demographic representation type, critical thinking and collaboration are needed to remain competitive in the current private and public sector environments. Workforce diversity enhances an organization's critical thinking and problem-solving capabilities.

Although there has been an increase in science and engineering degrees earned by women in the United States, some choose not to continue in an engineering career postgraduation (Fouad & Singh, 2011). Figure 3 demonstrates the percentage change of women in the STEM labor workforce over the past 50 years. Although careers in the social, life, and physical sciences have continued to increase, employment in mathematics and engineering has gradually increased. Engineers represent 15% of the percentage of women in the workforce as of 2019. According to the U.S. Bureau of Labor Statistics (2017b), in 2015, there were nearly 8.6 million STEM jobs in the United States, representing 6.2% of U.S. employment. Based on this data, computer occupations made up nearly 45% of STEM employment, engineers made up an additional 19%, and mathematical science occupations made up less than 4% of STEM employment. Mathematical science occupations were also projected to grow the fastest by 28.2% (U.S. Bureau of Labor Statistics, 2017a).

Figure 3

Percentage of Science, Technology, Engineering, and Math (STEM) Workers Who Are Women



Note. From "Women in the Labor Force: Percentage of Science, Technology, Engineering, and Math (STEM) Workers Who Are Women," U.S. Department of Labor, 2019d (https://www.dol.gov/agencies/wb/data/facts-over-time/women-in-the-labor-force#womenstem).

Although many scholars have researched the impact of retention of women pursuing STEM degrees in higher education (Heilbronner, 2009; Norrbom, 2019) and working in STEM fields within academia (Chong, 2020; Gilmer et al., 2014; Jensen, 2019; Whelan, 2017), as well as job satisfaction of engineers and scientists in Naval acquisition (Jenkins, 2008) and retention of women engineers and scientist within the federal government (Adolfie, 2009; Ware, 2019), there is a deficit of research focused on retention of women STEM professionals within a Navy federal laboratory and in particular, studies concerning the impact organizational culture may have on the retention

of women in these career fields. Corporate leaders at all levels need to focus on organizational culture to sustain an environment where employees stay for the impact they make and the contributions they give rather than what they get with regard to pay (Lavigna, 2013). Prior research conducted by Adolfie (2009) focused on women's representation in federal government science and engineering occupations at various national security federal agencies, and the research conducted by Ware (2019) focused on the disparity of minority female scientists and engineers in leadership, specifically in senior executive service positions, within the U.S. Air Force. This specific study can assist in informing leaders within STEM organizations and laboratories on the impacts organizational culture has on not only the retention of women in STEM but also human capital and the environment they operate in while striving to achieve its mission (Heath & Palenchar, 2009).

Definitions

Various individuals and groups in different professions and fields may interpret similar terms differently. Definitions of the key terms utilized throughout the study are provided as follows:

C5I. Combat systems command and control is referred to as C5I and encompasses everything C4I (command, control, communications, computers, and intelligence) does but includes combat systems as well (K. Jackson, 2015).

Corona Division. Naval Surface Warfare Center Corona Division, which is one of 10 Warfare Centers under NAVSEA.

Department of Defense (DOD). With 2.91 million service members and civilians, the Department of Defense is America's largest government agency with a

mission to provide the military forces needed to deter war and ensure our nation's security (U.S. Department of Defense, n.d.).

Engineering professional. Professional engineering and scientific positions in the physical, biological, mathematical, and computer sciences career fields. These positions are identified as being in the ND (Science and Engineering) pay band within the Science and Technology Reinvention Laboratories Demonstration Project (Science and Technology Reinvention Laboratory, 1997, § 64055).

Expert. "People with special knowledge or skills, most often equated with professionals from the fields of science, engineering, and technology" (Bogner & Menz, 2009, p. 5).

High-grade employee. As provided by the Naval Surface Warfare Center, Corona Division, Human Resources Office, a civil service employee approved to reach the GS-14, step 10 equivalent salary (NT-05 high-grade technical professional) or GS-15, step 10 equivalent salary (NT-06 technical professional or ND-05 high-grade engineering professional).

Human capital. "The knowledge, skills, and abilities that people embody across an organization" (Bauer et al., 2020, p. 29).

Leader. Gilmer et al. defined a leader as

> A person who has confidence and courage to act, can take the risks of embracing change, can empower others, be intellectually vigorous, can collaborate well and learn and enlist support from others, and be mature in her judgment, so she can transform culture rather than just reproduce culture. (p. 165)

Motivation. "The dynamic internal force that impels human behavior in a particular direction" (Friedman & Lackey, 1991, p. 7).

Naval Sea Systems Command (NAVSEA). Naval Sea Systems Command is the largest of the Navy's five system commands. In 2021, it had a fiscal year budget of approximately $36 billion, which accounts for nearly one quarter of the Navy's entire budget, and a force of 86,653 (as of 1 Oct 2021) civilian and military personnel. NAVSEA engineers, builds, buys and maintains the Navy's ships and submarines and their combat systems (Naval Sea Systems Command. (n.d.-d).

Navy Continuous Training Environment (NCTE). The Navy Continuous Training Environment (NCTE) enables Live Virtual Constructive (LVC) training with live and synthetic systems around the globe (Naval Sea Systems Command, n.d.-a.).

Organizational climate. Tagiuri (1968) describes organizational climate as,

> [A] relatively enduring quality of the internal environment of an organization that (a) is experienced by its members, (b) influences their behavior, and (c) can be described in terms of the values of a particular set of characteristics (or attributes) of the organization. (p. 27)

Organizational culture. "Creates and shapes an organization's activity by influencing the ideologies, values, beliefs, language, norms, ceremonies, and other social practices that ultimately shape and guide organized action" (Morgan, 2006, p. 142).

Science and Technology Reinvention Laboratories Demonstration Project (DEMO). Science and Technology Reinvention Laboratories Demonstration Project which is a pay-for-performance pay band system. This demonstration project provides

hiring, retention, and performance flexibilities for managers and high-performing employees (Science and Technology Reinvention Laboratory, 1997, § 64050).

Self-determination theory (SDT). Self-determination theory focuses on how social and cultural factors facilitate or undermine an individual's sense of volition and initiative, their well-being, and the quality of their performance (Center for Self-Determination Theory, n.d.). There are three psychological components of SDT: autonomy, competence, and relatedness (Ryan & Deci, 2000a, 2000b, 2017).

Self-efficacy theory (SET). Self-efficacy theory is a theory within the more extensive social cognition theory (Bandura, 1977) and refers to individuals' beliefs about their ability to successfully perform the activities necessary to achieve a desired outcome or result (Bandura, 1977, 1986).

Science, technology, engineering, and mathematics (STEM). Education and skill in science, technology, engineering, and mathematics. The Management (STEM+M) and Computer Science (STEM/CS) fields are also commonly included in STEM. As stated by the U.S. Department of Education (n.d.),

> If we want a nation where our future leaders, neighbors, and workers can understand and solve some of the complex challenges of today and tomorrow, and to meet the demands of the dynamic and evolving workforce, building students' skills, content knowledge, and literacy in STEM fields is essential. (para. 1)

Technical professional. Professional or specialist positions in such administrative, technical, and managerial fields as finance, procurement, human resources, computer, legal, librarianship, public information, safety, social sciences, and

program management and analysis; nonprofessional technician positions that support scientific and engineering activities through the application of various skills and techniques in electrical, mechanical, physical science, biology, mathematics, and computer fields. These positions are identified as being in the NT (Administrative and Technical) pay band within the DEMO project (Science and Technology Reinvention Laboratory, 1997, § 64056).

Test and Evaluation (T&E). This is in reference to military weapon systems.

Warfare Centers. According to Naval Sea Systems Command (n.d.-d), NAVSEA's Warfare Center Enterprise is comprised of the Naval Surface Warfare Center (NSWC) and the Naval Undersea Warfare Center (NUWC). With eight Surface Warfare and two Undersea Warfare sites across the United States, the Warfare Centers supply the technical operations, people, technology, engineering services, and products needed to equip and support the fleet and meet the warfighters' needs. The Warfare Centers are the Navy's principal research, development, test and evaluation (RDT&E) assessment activity for surface ship and submarine systems and subsystems. (para. 2)

Workplace Diversity. The acknowledgment, understanding, acceptance, value, and celebration of differences among people with respect to age, class, ethnicity, gender, physical and mental ability, race, sexual orientation, spiritual practice, and public assistance status (Farnsworth et al., 2002, p. 1).

Organization of the Study

The remainder of this study comprises an in-depth literature review in Chapter 2, which provides a foundational background on the following topics: women in STEM at

the global, national, organizational, and executive levels; the Science and Technology Reinvention Laboratories Demonstration Project which the participants in this case study are under; organizational culture; self-efficacy and motivation; and diversity. Chapter 3 of the study describes the methodology used for this research and provides the specific open-ended interview questions, sample size, data collection, and analysis procedures. The following chapter, Chapter 4, summarizes the actual research methods used during the research study and procedures in collecting the research data as well as an analysis of the data gathered during the qualitative interviews. The final chapter, Chapter 5, presents the key findings from the research to include any unexpected results, implications for action based on the research conducted, and recommendations for further study.

CHAPTER 2: REVIEW OF THE LITERATURE

This study sought to understand how women STEM professionals have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts, if any, can be attributed to organizational culture. The literature reviewed for this study consisted primarily of U.S. government websites, previous doctoral studies conducted on the topic of Women in STEM, and peer-reviewed articles. The literature review provides a background of women in STEM at the global, national, organizational, and executive levels; the Science and Technology Reinvention Laboratories Demonstration Project, which the participants in this case study participate in; organizational culture; and self-efficacy and motivation.

The literature review establishes the theoretical foundation for this study and assists in describing the significance of this study within the field of public administration. Although the issue of recruitment and retention of women in the STEM career fields is described in detail throughout this study, to fully understand the significance of this study, a background of women within the STEM career fields is required. The literature review begins with a background and history of women in STEM.

History of Women in STEM

A study conducted from 2000 to 2015 by the National Science Foundation (2018) found that although there has been an increase in science and engineering degrees earned in the United States at all levels of higher education, the most significant increase being 136% in associate-level degrees, of these degrees three quarters were in health technologies, and the other quarter were in engineering technologies. In that same study,

bachelor's and doctoral-level degrees averaged a 60% increase while master's level degrees had an 88% increase. Even with these increases, the United States is not keeping pace with the competency demand gained from degrees in science and engineering. Noonan (2017) observed that the STEM workforce is crucial for generating new ideas and providing the flexibility and critical thinking required in the modern economy.

Women in STEM: Global Perspective

According to the National Science Foundation (2018) study, in 2014, science and engineering degrees at the bachelor's and "first university" levels made up 7.5 million of the total 22 million degrees earned globally. Of those degrees, Asian universities awarded 4 million degrees, more than half in engineering, and European universities awarded 1.5 million degrees, 40% being in an engineering field. In contrast, based on the study, universities in the United States awarded 1 million degrees in the science and engineering fields, 24% of those degrees being in engineering. Based on the Credit Suisse Research Institute (2019) study, gender diversity in management fields has resulted in women representing 17% of managers in Europe, 19% of managers in Asia-Pacific, and 21% of managers in the United States. As demonstrated in Table 1, more than 25% of women in the European Union, France, and Sweden are in the engineering, manufacturing, or construction fields, and women in Germany, Netherlands, and the United Kingdom make up 20% or more of the workforce in these same fields. Based on this data, the United States is only outperforming Switzerland regarding gender diversity in engineering.

Table 1

Women's Share of Bachelor's Degrees in STEM Fields

Country	Natural sciences, mathematics, and statistics	Information and communication technologies	Engineering, manufacturing, and construction
European Union (EU-28)	54.8%	19.8%	26.7%
France	53.7%	15.4%	25.4%
Germany	46.1%	19.6%	20.0%
Netherlands	45.2%	10.3%	21.9%
Sweden	58.6%	33.8%	35.9%
Switzerland	41.0%	8.9%	13.7%
United Kingdom	55.0%	15.7%	21.0%

Note. Adapted from Eurostat Database, "Graduates by Education Level, Programme Orientation, Sex and Field of Education," 2020 (https://ec.europa.eu/eurostat/web/products-datasets/product?code=educ_uoe_grad02).

Women in STEM: United States of America

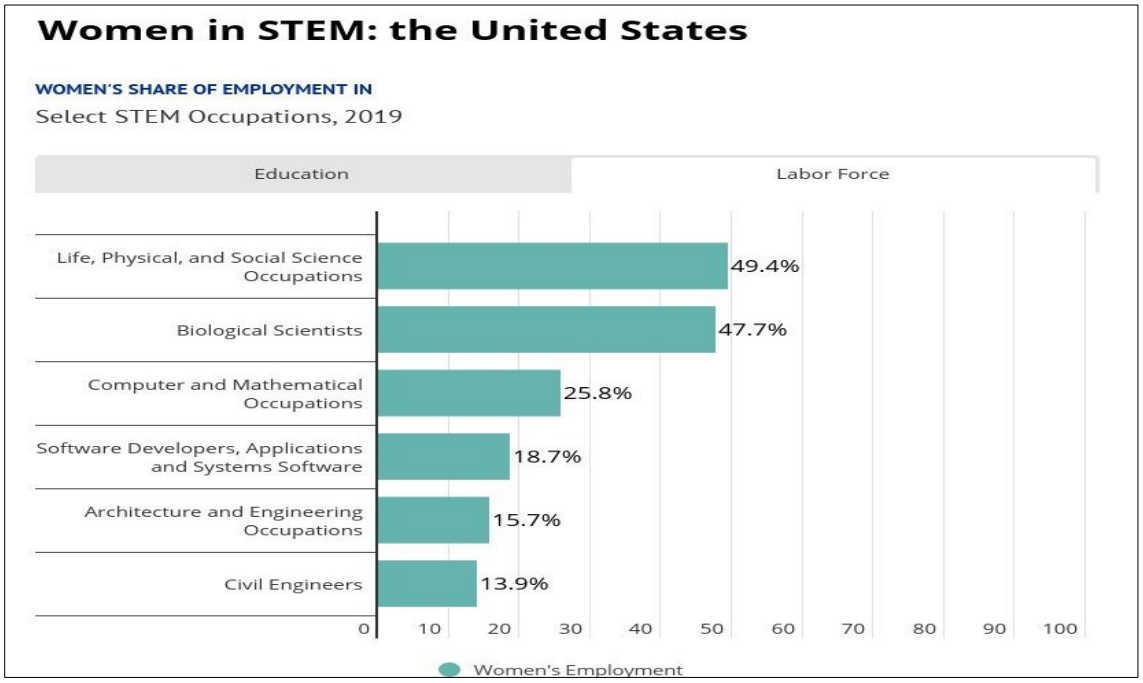
In the United States, women in engineering undergraduate programs make up about 20% of graduates. Of these graduates, 17% on average work in the engineering field. Although women comprise 43.5% of the workforce across all occupations, in engineering occupations, they comprise 14.1% of the total workforce occupations (U.S. Department of Labor, 2019a). In 2019 within the United States, women only made up 7.9% of mechanical engineers, 8.1% of electrical engineers, and 10.1% of engineering managers (U.S. Department of Labor, 2019b).

Another study from 2019 found that women made up 13.9% of civil engineers, 18.7% of software developers, and 25.8% of computer and mathematical occupations (Catalyst, 2020). The summary findings from the study, found in Figure 4, show that

while women in the engineering, software development, computer, and mathematics fields comprised the lower percentages of the labor force, the physical sciences dominated the STEM career fields for women. Those findings further highlight the need to develop and retain women in these career fields.

Figure 4

Women's Share of Employment in STEM



Note: From "Women in Science, Technology, Engineering, and Mathematics (STEM) (Quick Take)," Catalyst, 2020 (https://www.catalyst.org/research/women-in-science-technology-engineering-and-mathematics-stem/).

According to a 2012 study, a Department of Defense workforce competence in STEM+M (STEM and management) is needed to keep pace with the performance, reliability, and survivability demands on networks, which form the basis of a coherent military force (National Academies of Sciences, Engineering, and Medicine, 2012). For

over a decade, an amplified focus has been on increasing the number of women in STEM+M positions in both the private and public sectors. Still, the focus has not yet yielded the intended results in many organizations. Although there have been advancements in the number of women entering STEM fields, engineering continues to be a group of occupations with the smallest number of women represented in the United States (U.S. Department of Labor, 2019b).

Even though women continue to be a small portion of the STEM workforce, there are more women in the workforce today than there have been in the past. According to the U.S. Department of Labor, on average, women are represented at a higher rate than men in the public sector; however, this is reversed in the private sector, where men have greater representation than women (U.S. Department of Labor, 2019c). In her study of 13 C-Suite Black women executives, Womack Johnson (2016) sought to provide additional insight into the lived experiences of these women executives across the public, private, and governmental sectors. The impact of women in STEM is an issue that transcends public administration organizations.

Women in STEM: C-Suite Executive Impact

As highlighted by a study that included 317 companies, 40,000 employees, and 45 in-depth interviews, one in five C-suite leaders are women, and it is projected to take over 100 years for there to be gender parity in the upper levels of corporations in the United States (Coury et al., 2020). That time frame covers multiple generations and highlights the impact of needing to fix the "broken rung" found at the entry-level and first step to management and in developing and sustaining women in the workforce at all levels of management. This study also supports Teller's (2011) research, which sought to

understand why mentees failed to reach the C-suite within large organizations. This fix is needed to build gender parity in the candidate pool so that women are ready and able to compete among their peers regardless of gender.

Another recent study found that companies with a higher than 30% representation of women on their executive teams outperform their competitors, including those with between 10 to 30% representation (Dixon-Fyle et al., 2020). The same study found that only about 4% of companies have more than 40% of women on their executive team; however, 42% of companies have 10% or fewer female executives (Dixon-Fyle et al., 2020). Research conducted by the Credit Suisse Research Institute (2019) found that women make up 5% of Chief Executive Officers (CEO) and less than 15% of Chief Financial Officers (CFO). As of 2021, Corona Division has a 20% representation of women on its executive team, the federal government equivalent of the CEO and CFO both being women.

In their research of women Senior Executive Service members in the Washington, D.C. area, Davis (2003) and Dickerson (2010) found that navigating the upward mobility career path can prove to be quite the challenge for women in the federal civil service at all levels because of systematic issues limiting career growth. These systematic issues can range from lack of role models, inclusion, or focus on diversity. A 2019 study conducted by Abbott found that STEM leadership typically centers on three different but complementary characteristics including the ability to lead the business, lead the team, and lead toward the future. These complementary characteristics include the ability to lead, which is a skill not often taught in STEM-related education but repeatedly demonstrated by executives in the federal government. When senior leaders at Abbott

were asked whether there were things employees and leaders can do to set themselves on the path to being a solid STEM leader, the responses centered on the ability to practice servant leadership, share ownership, and build a culture of communication, trust, and transparency. These are not STEM skills but leadership and relational skills requiring high leadership and interpersonal communication self-efficacy.

Women in STEM: Naval Surface Warfare Center Corona Division

Corona Division is located in Norco, California, and has detachments in Fallbrook, California, and Seal Beach, California, with 14 field sites located around the country and in Japan. Corona Division employees routinely support Department of Defense, US Navy, and US Marine Corps operations globally including both on ship and on shore. As described by Naval Surface Warfare Center Corona Division (Naval Sea Systems Command, n.d.-b), the support provided includes

- Conducting analytical data-driven performance assessments on offensive and defensive systems of the surface Navy supporting acquisition Test and Evaluation (T&E) and Fleet exercise feedback. (para. 1)
- Providing the Fleet and Shore community with transparency into the material readiness of critical weapon, combat, C5I (Command, Control, Communications, Computers, Combat Systems, and Interoperability), and HM&E (Hull, Mechanical, and Electrical) systems and the factors that are driving material readiness. Products and services have broad utilization across Navy Program offices, In Service Engineering Agents, Regional Maintenance Centers, Office of the Chief of Naval Operations (OPNAV), and the Fleet. (para. 2)

- Providing quality and mission assurance for Strategic and Missile Defense systems that have a very low tolerance for failure or problem systems where the program manager requests focused support. Corona develops and tailors Quality and Mission Assurance (Q&MA) requirements which outline program office expectations for management and customer involvement in key technical processes during acquisition and sustainment such as system engineering, test, configuration control, reliability, and manufacturing. (para. 3).
- Serving as the Navy's Test and Monitoring Systems technical advisor responsible for disseminating calibration guidance to over 2,750 personnel across the Naval enterprise and ensuring accurate and traceable measurements to international standards to reduce the risk of wrong test decisions and improve Fleet lethality. Corona authors the detailed calibration procedures used to perform nearly 500,000 calibrations each year on the Navy's more than 1.6 million pieces of test equipment and uses the results from these calibrations to establish and optimize calibration periodicities to ensure the proper risk vs. cost trade-off. (para. 4)
- Providing Naval surface and air range systems engineering and technology solutions for Naval and Joint training and testing, engineering, integrating, and installing instrumentation on test and training ranges, including shipboard systems and remote range areas. Corona operates and maintains Fleet tactical training ranges and network environment and is the Fleet's technical

engineering agent for the Fleet training live, virtual, and constructive (LVC) capability. (para. 7)

As depicted in Table 2, in October at the end of fiscal year 2021, women comprised 25% of the total Corona Division workforce population consisting of 1,963 government civil service employees. According to the Corona Division Human Resources Office,[1] women also represented 27% of first-level supervisors (branch heads), 23% of second-level supervisors (division heads), and 27% of third-level supervisors (department heads and deputy department heads) or technical high-grades (national subject matter experts in technical areas).

Table 2

Corona Division Historical Workforce by Gender as of October 2, 2021

Information by gender	2016	2017	2018	2019	2020	2021
Female information						
Separations	25	24	25	32	38	31
Hires	65	49	76	74	66	63
Onboards	290	314	370	420	453	490
Non-high-grades	274	295	349	394	427	463
High-grades	16	18	20	25	25	26
SSTM	0	0	0	0	0	0
SES/ST/SL	0	1	1	1	1	1
Male information						
Separations	67	80	98	131	91	102
Hires	145	212	177	198	181	160
Onboards	997	1,127	1,230	1,304	1,404	1,473
Non-high-grades	936	1,056	1,161	1,226	1,322	1,385
High-grades	61	70	68	77	80	85
SSTM	0	1	1	1	2	3
SES/ST/SL	0	0	0	0	0	0

[1] Citation not included because the information is not publicly available.

Employees at this third level of supervision or technical level of expertise and a select few in the second-level of supervision are often referred to as high-grades because they are recognized as senior managers and technical experts in the organization. These professionals are eligible for their pay to exceed 75% of their DEMO performance band because of their national impact and span of influence in their field. Table 3 identifies the specific high-grade positions occupied by women at Corona Division as of January 17, 2022 (see Footnote 1). They are listed by primary position type, title of position, and whether the position is in a STEM or business functional area as well as whether it is a management position within one of these two functional areas (Business+M or STEM +M).

Only high-grade positions identified as being in the STEM or STEM+M career fields and occupied by women were potential participants for this research study. In October 2021, 5.7% of Corona Division's total workforce was identified as being a high-grade professional. Of this 5.7%, 24% were women (27), and 76% were men (85), resulting in women representing just under a quarter of total high-grades across the Command. Of the 490 women in the organization, 209 were identified as being in the ND pay band, and 12 were in supervisory or technical high-grade positions. In addition, 277 were identified as being in the NT pay band with 14 identified as being in a supervisory or technical high-grade position. Although this number may seem low, by gender, there is less than 0.5% difference between women high-grades and men high-grades in the organization. In addition, 5.5% of total women and 5.7% of total men were high-grades, resulting in a difference of 0.2% between the two genders.

Table 3

High-Grade Positions Occupied by Women as of January 17, 2022

Position	Functional area
Senior executive service (SES) and department head	
01, Comptroller department head	Business+M
TD, Technical director (SES)	STEM+M
Deputy department head and operations manager	
Acquisition and readiness assessment department, operations manager	Business+M
Corporate operations department, deputy department head	Business+M
Performance assessment department, operations manager	Business+M
Technical subject matter experts	
C5I systems readiness assessment advocate	STEM
General counsel, office of counsel	Business
Information management technical lead	STEM
Information system security manager (ISSM)	STEM
Interoperability assessment	STEM
NCTE chief information technology officer	STEM
Surface missile systems performance assessment	STEM
Weapon and combat systems advanced technology assessment	STEM
Division head	
012, Accounting officer, division head	Business+M
013, Employee services officer, division head	Business+M
022, Contracting officer, division head	Business+M
101, Human resources director, division head	Business+M
102, Infrastructure, division head	STEM+M
104, Information technology, division head	STEM+M
105, Security director, division head	Business+M
107, Property management, division head	Business+M
MS20, Interface engineering and assessment, division head	STEM+M
MS30, Metrology engineering, division head	STEM+M
Branch head	
0221, Contracting officer, branch head	Business+M
0222, Contracting officer, branch head	Business+M
0223, Contracting officer, branch head	Business+M
0232, Contracting officer, branch head	Business+M

Note. Business+M = business and management; STEM +M = STEM and management.

An internal study conducted by Corona Division in 1989[2] sought to identify potential challenges within the organization regarding the development and retention of women engineers and concerns with women not applying for promotion opportunities. The study was conducted by a male employee selected to interview 10 women engineers in various capacities throughout the organization who he felt had the potential for higher levels of responsibility but were not applying for promotion opportunities. At the time of the internal study, there were no women in high-grade positions. The study identified several potential barriers to women applying for or accepting leadership positions to including it being a waste of time because preselection of candidates was occurring, not wanting to take a higher level role or be the first in the position due to the pressure of being in the spotlight and the perceived expectation to fail rather than succeed, a work–life balance between family and job requirements resulting in careers being placed on hold, lack of a women's network or employee group to share experiences, and lack of accountability of leaders.

This internal study is significant to this research because it was conducted during a time when several of the current study participants were beginning their careers with Corona Division. Based on the over 30-year-old study results, Corona Division at the time was not a highly supportive, gender diverse, or open environment where women STEM professionals were valued. There were no role models for women in STEM or pursuing STEM degrees to look up to. As a result of the internal study, several initiatives were implemented to increase transparency and create a more inclusive work environment. Today the senior executive in the organization is a woman engineer.

[2] Citation not included because the internal study is not publicly available.

Women make up on average 24% of leaders at all levels of the organization, including the Command's 10-person executive steering group (20%). In 2019, Corona Division was also recognized by the Society of Women Engineers for its positive impact on women in engineering and had women represented at all levels throughout the organization (Clarke, 2018). Although the organization has progressed in balancing the gender gap between women and men in the STEM career fields, more can potentially be done. As a Science and Technology Reinvention Laboratory within the Department of Defense, one way Corona Division has been able to recruit and retain STEM professionals has been through its pay-for-performance pay band system, which provides various flexibilities for managers.

Science and Technology Reinvention Laboratories Demonstration Project

Most federal government employees are under the general schedule (GS) pay system administered and managed by the Office of Personnel Management. The GS pay system was established by the Classification Act of 1923, refined in the Classification Act of 1949, and codified in Chapter 53, Title 5 U.S.C. §§ 5331-5338 (GeneralSchedule.org, 2016). Before 1998, NAVSEA Warfare Center employees were also under the GS pay scale. The National Defense Authorization Act for Fiscal Year 1995 (1994) authorized the Secretary of Defense to conduct a Personnel Demonstration (DEMO) project at Department of Defense (DoD) laboratories designated as Science and Technology Reinvention Laboratories. In 1998, the NAVSEA Warfare Centers were approved to implement DEMO, including establishing a pay-for-performance pay band system (Science and Technology Reinvention Laboratory, 1997, § 64050).

Instead of employees moving through 15 grades with 10 levels under the GS pay scale, they would now transition into up to six broad pay bands broken down by separate career paths: Scientific and Engineering (ND), Administrative and Technical (NT), and General Support (NG). These career paths create an opportunity for agencies to encompass multiple series and provide maximum flexibility for the organization to assign individuals consistent with the organization's needs, established level or rank that the individual has achieved, and the individual's qualifications (Science and Technology Reinvention Laboratory, 1997, § 64055). This demonstration project provides hiring, retention, and performance flexibilities for managers and high-performing employees. One of the reasons the NAVSEA Warfare Centers transitioned to the DEMO project was to provide a clear progression of employee performance levels beyond the full performance level, especially for science/engineering occupations where career progression through technical as well as managerial career paths is essential (Science and Technology Reinvention Laboratory, 1997, § 64053). Being under the DEMO project is one of several tools Corona Division has to recruit and retain its highly sought-after STEM talent; however, as Chase (2006) found, organizations focused on creating a culture of continual improvement are interested in engaging all employees by understanding the factors that impact whether or not employees have the motivation to lead change. An effective pay-for-performance is one of several ways to motivate employees; however, a supportive and positive organizational culture can be a driving force for employee motivation.

Motivation and Organizational Culture

Organizations with positive corporate cultures are effective in promoting the intellectual contribution of today's highly skilled multicultural workforce (McMillan, 2010). Shared systems of meaning and understanding, often referred to as an organization's cultural norms, continually evolve and form an organization. An organization's culture consists of many different assumptions, artifacts, behavioral patterns, languages, symbols, and subcultures that often have the most significant impact on the culture (Schein, 1999). Just as the human brain is formed by billions of neurons that are interconnected via neuronal synapses, the real potential for organizations lies in the ability to create networks of interactions that can self-organize and be shaped and driven by the intelligence of everyone involved (Morgan, 2006; The Human Memory, 2020). This opportunity creates an organization's culture and its fundamental interagency network (Gormley & Balla, 2013) where information is shaped and changed as it is shared. Morgan (2006) referred to culture as an evolved form of social practice influenced by many complex interactions between people, events, situations, actions, and general circumstances. This experience forms the foundation of an individual's personal beliefs, values, and perspectives, thus influencing behavior and decision making. Organizational cultures and structures can be impactful on decision making and organizational effectiveness.

In both the public and private sectors, employees are "socialized by the organizations they work in, and they adopt behaviors and preferences that are consistent with organizational goals, thereby minimizing the influence of their values on bureaucratic behavior" (Wilkins & Williams, 2009, p. 778). In government

organizations, this can limit the diversity of thought and hinder innovation if not addressed. Organizations are ever changing and forming even with this risk, just as their workforce is, and effective organizational change implies cultural change (Morgan, 2006). For STEM organizations to be prepared to take on the complex problems of the future, they will need to have their best and brightest at the table making decisions regardless of gender.

Theories Associated With Motivation

There are numerous motivation theories related to individuals and organizations. Maslow's (1943) five-tiered hierarchy of needs theory, which is often depicted as a pyramid, focused on individuals needing to move from the bottom of the first tier in the pyramid up. Individuals could not move up the pyramid without first fulfilling the needs of each previous tier. According to Maslow (1943, 1954), the hierarchy of an individual's needs from the bottom up included: (a) physiological (food, shelter, clothing, etc.), (b) safety (feeling of security, employment, health, etc.), (c) love and belonging (interpersonal relationship, friendship, trust, etc.), (d) esteem (dignity, mastery, prestige, etc.), and (e) self-actualization (realization of potential, self-fulfillment, purpose, etc.). Maslow believed that human motivation was tied to this hierarchy of needs and that basic needs at the bottom of his pyramid needed to be fulfilled before higher-level needs could be met.

McClelland (1961) developed the learned needs theory as an alternative to Maslow's (1943, 1954) hierarchy of needs theory. He argued that individuals have three motivators resulting from their culture and lived experiences instead of a specific hierarchy of needs, and one would be their dominant motivational factor. The three

motivators within his approach include power, achievement, and affiliation. These three motivators best align with Maslow's love and belonging, esteem, and self-actualization needs.

In addition to Maslow's hierarchy of needs theory and McClelland's learned needs theory, Alderfer (1969) developed his existence, relatedness, and growth (ERG) theory. Alderfer's theory best aligns with Maslow's hierarchy of needs theory and focuses on three groups of individual core needs rather than five. These needs include existence, relatedness, and growth. According to Alderfer, existence incorporates the first two tiers of Maslow's hierarchy of needs and encompasses an individual's basic needs to live. The relatedness need in Alderfer's theory further comprises Maslow's love, belonging, and esteem hierarchy of needs. This need centers on individual needs focused on interpersonal relationships, love, and respect.

The final need in Alderfer's ERG theory is growth, which encompasses the esteem and self-actualization needs within Maslow's theory. Maslow (1943, 1954) believed individuals needed to progress through each tier within his theory in sequence and needed to reach a high level of fulfillment in the tiers below the tier they were in. In contrast, Alderfer (1969) found that individuals would often increase their focus in a different categorical need within his theory when one was not being met and did not need to meet the needs in one category to further develop in another. These theories formed a foundation for Ryan & Deci's (2000a, 2000b, 2017) self-determination theory and Bandura's (1977, 1986) self-efficacy theory, which heavily focus on intrinsic motivation factors.

Self-Determination Theory

Self-determination theory (SDT) is centered on human motivation and individual personality as they relate to intrinsic and extrinsic sources of motivation. The theory focuses on how social and cultural factors facilitate or undermine an individual's sense of volition and initiative, their well-being, and the quality of their performance (Center for Self-Determination Theory, n.d.). There are three psychological components of SDT: autonomy, competence, and relatedness (Ryan & Deci, 2000a, 2000b, 2017). The first psychological component, autonomy, is associated with an individual's belief that they control their decisions and choices. The second component, competence, is associated with an individual's belief that they have the necessary knowledge and skills to perform a task successfully. The final psychological component is relatedness which is associated with an individual's sense of belonging with an individual or group of individuals, such as a team. According to Ryan and Deci (2000b), extrinsic sources of motivation such as social and environmental factors contribute to a person's intrinsic sources of motivation and feelings of autonomy, competence, and relatedness. Based on this, an organization's culture can directly impact an individual's motivation.

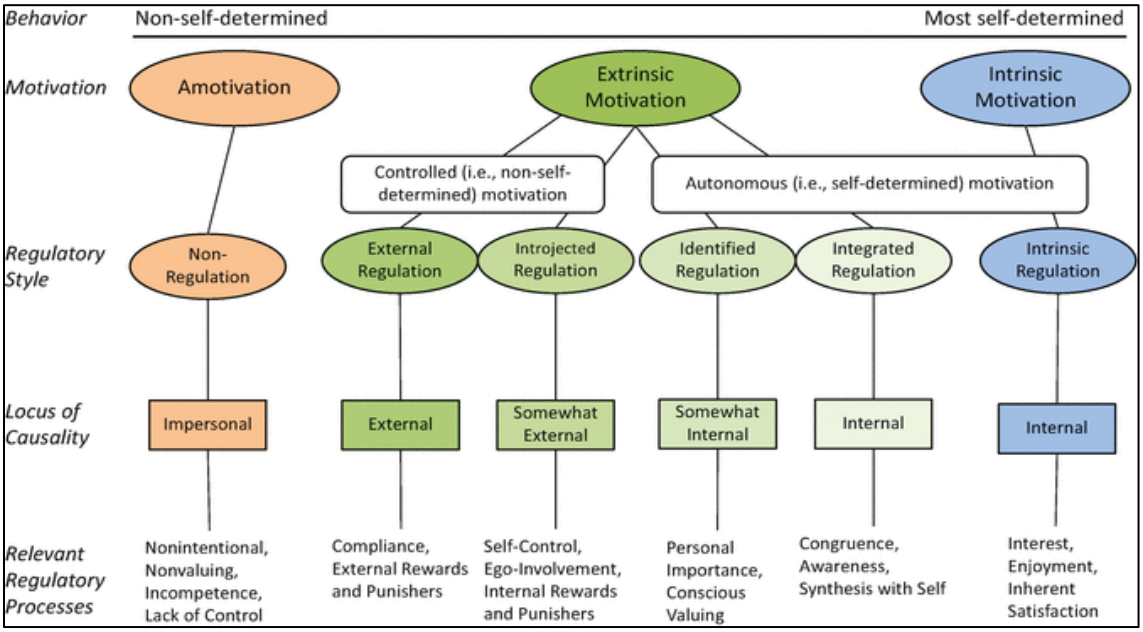
SDT is composed of six mini-theories focused on understanding the various factors that either facilitate or impede an individual from experiencing self-determination (Ryan & Deci, 2017). The first theory is cognitive evaluation theory (CET), which aims at identifying social factors that describe intrinsic motivation (Ryan & Deci, 2000a). The second theory is the organismic integration theory (OIT), which provides various types of intrinsic and extrinsic motivation across what is commonly referred to as the self-determination continuum (Ryan & Deci, 2000a, 2000b, 2017).

The self-determination continuum is organized from left to right, as demonstrated in Figure 5, and categorizes various types of motivation as described by Ryan and Desi (2000b). Vertically the continuum is organized by factors such as behavior, motivation, regulatory style, locus of causality, and relevant regulatory processes. Horizontally the continuum transitions from non-self-determined to most self-determined behavioral factors. The motivation factors along the self-determination continuum include amotivation, extrinsic motivation, and intrinsic motivation. Amotivation is identified as a non-self-determined behavioral factor in which there are no intentional motivation factors demonstrated. Amotivation is on the far left of the continuum and occurs when individuals lack control and an intent to act on their goals. On the opposite side of the continuum, intrinsic motivation is identified when there is a high level of internal interest, satisfaction, or purpose. In the behavior factor within the continuum, intrinsic motivation is identified as most self-determined. Intrinsic motivation occurs when individuals are engaged, interested, and complete tasks based on their inherent satisfaction in doing so. Between these two is extrinsic motivation, which includes both controlled motivation and autonomous motivation factors across the spectrum. Extrinsic motivation is driven by either external or internal factors depending on the individual. Moving along the continuum, individuals experience less autonomy on the left and increased autonomy as they move to the right.

The third mini-theory is causality orientations theory (COT), which highlights the reasons individuals may be different even when they are in the same social setting (Ryan & Deci, 2017). Basic psychological needs theory (BPNT) is the fourth mini-theory and suggests that psychological needs for autonomy, competence, and relatedness are

Figure 5

Self-Determination Continuum



Note. From "Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being," by R. M. Ryan and E. L. Deci, 2000b, *American Psychologist*, *55*(1), p. 68.

inherently human needs and an individual's environment can either positively support or negatively impact individuals from thriving (Ryan & Deci, 2017). The fifth mini-theory is goals contents theory (GCT), which highlights how the differences between intrinsic and extrinsic goals impact an individual's motivation and wellness (Ryan & Deci, 2017). The final SDT mini-theory is relationship motivation theory (RMT), which is intrinsic and focused on relationships' quality and consequences (Ryan & Deci, 2017). Although Ryan and Deci (2000a) identified SDT as being centered on human motivation and individual personality, including the psychological components of autonomy, competence, and relatedness, Bandura (1977) found that an individual's level of self-

efficacy can be the determining factor between an individual understanding of what needs to be accomplished and accomplishing it based on their level of self-belief in their skills and abilities.

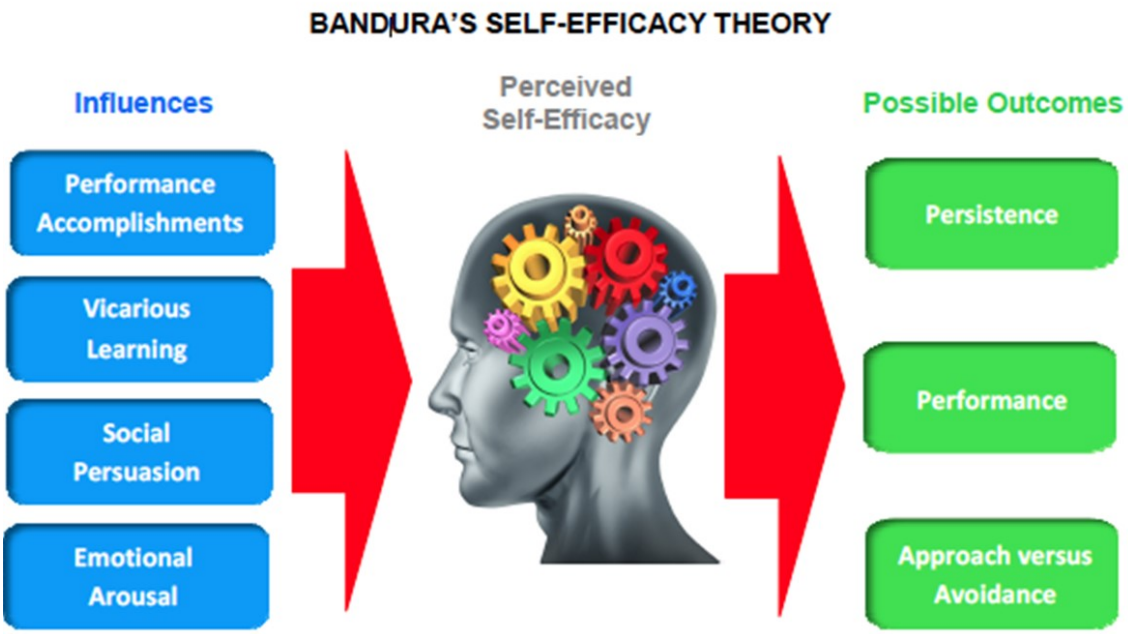
Self-Efficacy Theory

Self-efficacy is a cognitive construct that refers to individuals' beliefs about their ability to successfully perform the activities necessary to achieve a desired outcome or result (Bandura, 1977, 1986). Figure 6 provides an overview of the theory regarding the influences and the possible outcomes. An individual's belief in their ability to provide or deliver a product, supervise teams, or lead organizations can be attributed to their level of self-efficacy (Bandura, 1977, 1986). Self-efficacy theory (SET) is a theory within the more extensive social cognitive theory (Bandura, 1977) and is part of the process theories within the even more prominent motivational theories.

Process theories focus on understanding how people are motivated instead of what will motivate people. There has been extensive research on what motivates women to pursue and leave careers in engineering, their struggles along their journey, and the ongoing struggle of competing in a male-dominated industry (Fouad & Singh, 2011; Gilstein, 2021; White, 2021). Task-specific self-efficacy growth contributes to general self-efficacy beliefs by improving the motivational process, reducing stress perception, improving life satisfaction, and achievement realization (Bandura, 1997). Individuals with a high sense of efficacy visualize success in all scenarios including their professional and personal tasks (Bandura, 1993).

Figure 6

Self-Efficacy Theory



Note: From "The Importance of Self-Efficacy," by OVP Management Consulting Group, November 16, 2018 (https://bit.ly/3zEoLtw).

In his research, Gandhi (2009), identified that in addition to individual preferences and behavior, emotional intelligence traits such as self-efficacy and an extroverted communication style can have a higher priority in organizations over technical expertise within leadership positions. Understanding how and why women engineers were motivated to continue in their profession, the variables that have impacted their decisions, and the lessons learned along their journey can help inform whether self-determination or self-efficacy has had any impact. SET focuses on an individual's belief in accomplishing a task, but SDT focuses on their motivation to do so. Based on Bandura's (1977) theory, the higher an individual's self-efficacy in an area, the higher the probability of them completing the task at an acceptable level or higher. Understanding

whether there needs to be a greater focus on self-efficacy or self-determination and how best to increase one or both in women STEM professionals can be insightful to future STEM professionals and leaders, regardless of gender, and other highly technical and paramilitary organizations.

Organizational Culture and Diversity

The organizational culture within the DoD is unique as most government employees and contractors are required to hold a security clearance of some kind. This requirement can impact diversity because the 1911 Defense of Secrets Act (U.S. Congress, 1911) requires that all employees with a security clearance in support of the DoD be citizens of the United States. Within the Department of the Navy (DON), military and civilian personnel are also required to be aware of personnel security eligibility standards and reporting requirements, which includes only U.S. citizens being eligible for a security clearance or assignment to a sensitive national security position (Secretary of the Navy, 2020). Other regulations like the 1961 Affirmative Action Act (Peters & Woolley, n.d.) and the 1978 Civil Service Reform Act require or advocate for a government supervisory structure that reflects the workforce. This goal is commonly achieved by purposefully recruiting, hiring, and promoting a diverse workforce; however, as Dickerson (2010) identified in her research, regardless of how diverse an organization's workforce is, most leadership teams are not reflective of their workforce.

Although the employees who make up the public and private sector workforce commonly represent a diverse social, cultural, and professional perspective in the Southern California area, this is often not experienced at the national level, which results in underrepresented organizations not fully benefiting from the diversity of thought and

perspectives provided by a diverse workforce at all levels. In his research on career progression issues for women in the federal government, Taylor (2004) found that issues such as laissez-faire management approaches and lack of role models impeded the diversity of candidates. As cited in Reardon (2019), Lyle highlighted that in 2015, White men made up 49% of science and engineering professionals while Asian and underrepresented minority women made up about 10%. Lyle also found that across all racial and ethnic groups, the number of men dominated the number of women in science and engineering occupations.

In a more recent Pew Research Study, Fry et al. (2021) found that "Black and Hispanic workers remain underrepresented in the science, technology, engineering, and math (STEM) workforce compared with their share of all workers, including in computing jobs, which have seen considerable growth in recent years" (para. 1). Although there has been a long-standing effort to increase diversity in STEM fields, the effort is not keeping pace with forecasted demand and is moving at a snail's pace. Fry et al. highlighted this lack of movement in their findings, highlighting that women continue to be vastly underrepresented in the ranks of engineers and architects (15%). Still, their share has increased slightly from 14% in 2016. A 1% increase over 5 years is not moving the needle regarding diversity and inclusion of women in engineering.

Organizational Climate

> Tagiuri (1968) defined organizational climate as a
>
> relatively enduring quality of the internal environment of an organization that (a) is experienced by its members, (b) influences their behavior, and (c) can be

> described in terms of the values of a particular set of characteristics (or attributes) of the organization. (p. 27)

Although Tagiuri provided three traits of organizational climate in his definition, the concept is generally credited to earlier research conducted by Lewin et al. (1939) on aggressive behavior in adolescent boys and the impact the leader's behavior had on each group of boys across the research groups. Building from this study, Litwin and Stringer (1968) connected organizational climate and motivation in their description of organizational climate as "a set of measurable properties of the work environment, perceived directly or indirectly by the people who live and work in this environment and assumed to influence their motivation and behavior" (p. 1). This definition was based on their research conducted across several manufacturing companies in 1967. It was further expanded by Stringer (2002) when describing the relationship between employee behavior, employee attitudes, employee motivation, and organizational climate. More recently, in her *Harvard Business Review* article, Yohn (2017) provided the perspective that

> when your brand and culture are aligned and integrated, you increase operational efficiency, accuracy, and quality; you improve your ability to compete for talent and customer loyalty with intangibles that can't be copied; and you move your organization closer to its vision. (para. 13)

Multicultural Organizations and Inclusion

B. Jackson (2014) described multicultural organization development as the process of building organizations and organizational cultures that include people from multiple socially defined group identities—race, ethnicity, gender, sexual orientation,

nationality, class, religion, and other social and cultural groupings—to enhance its competitive advantage by advocating and practicing social justice and social diversity internally and external to the organization. With over 150,000 scientists and engineers working at the DoD, the department is focused on cultivating a collaborative environment where its workforce leads modernization efforts in areas such as advanced manufacturing, robotics, artificial intelligence, biotechnology and more (DoD STEM, n.d.). Although this study primarily focused on the inclusion and development of women high-grade leaders in the STEM career fields, organizational inclusivity is a force multiplier and catalyst for a diversity of thought when attempting to solve the complex problems of today and tomorrow. In her study, which included 12 executive-level women at the Los Angeles County Metropolitan Transportation Authority, Licea (2013) found that although emerging changes in social and organizational structures are evolving, especially a shift to more humanistic and collaborative organizational structures, women must educate themselves in nontraditional female fields like engineering and the sciences, join professional organizations, increase their network, and practice mentoring because they will have to work harder than men and have more education and credentials. Although that should not be the case for just women in a multicultural or inclusive organization, it highlights the need to understand further the factors that came into play in the professional careers of Corona Division high-grade women STEM professionals.

With ever-growing changes in workplace structures, political environments, and global challenges in the public and private sectors, multicultural organizations and perspectives will continue to be needed. As Hassan (2009) highlighted in his research

findings, “diversity in the workplace represents a tool—not a burden—and many organizations have been slow to devise programs that capitalize on the talents, ideas, and perspectives of a diverse staff” (p. 4). Organizational diversity throughout an organization helps to establish an environment that fosters and promotes inclusivity. The Navy and DoD have been leaders in diversity and inclusion programs and initiatives, have long understood that the diverse makeup of the armed forces is one of its greatest assets, and that when service members of different races, ethnicities, religions, sexual orientations, and other identities unite for a common mission, the result is a stronger and more effective force (Military One Source, 2021). Successful multicultural organizations like the Navy have integrated minorities and women at all management levels. As found in Allen and Montgomery’s framework (2001), multicultural organizations are the most advanced with respect to implementing diversity and promoting inclusivity across their organization.

Summary

Chapter 1 introduced the research by framing the need to understand the strategies, skills, and behaviors developed and demonstrated by successful women STEM leaders within a military federal laboratory environment. The problem is both significant and contemporary because the demand for women and men in STEM fields is growing exponentially, and the leaking pipeline continues to present itself. By understanding the internal and external factors that have compelled high-grade women professionals to persist and succeed in the STEM career fields, there may be hope in reducing or mitigating the effects of the leaking pipeline sooner in the undergraduate and graduate education of women in STEM and sustaining them in their chosen STEM career fields.

This will enhance diversity of thought, create an increased culture of inclusion, and develop a new definition for men and women STEM professional as simply STEM professionals, without a gender placed in front of the profession.

Chapter 2 covered the prevalent research in two parts. The first part provided an overview of women in STEM from a global, national, private, and public sector perspective with the public sector perspective specific to Corona Division women high-grade STEM professionals. The second part provided an overview of organizational culture and motivation. The first section explained SDT and SET related to this research, and the second section focused on organizational culture and diversity, impacts of organizational climate on motivation, and the importance of having multicultural organizations from an inclusivity perspective.

Chapter 3 follows with the research methodology including details about the research method, design, target population, and sampling processes. Chapter 4 presents the results and data analysis. Finally, Chapter 5 summarizes the conclusions and major findings of this research.

CHAPTER 3: METHODOLOGY

Purpose Statement

This study sought to understand how women STEM professionals have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts, if any, can be attributed to organizational culture. This chapter presents the research questions, research design, population and sample size, instruments used, data collection and analysis methods, and the study's limitations. A qualitative phenomenological case study was utilized to understand the study participants' lived experiences. Qualitative research provides an opportunity for the researcher to develop a holistic and rich narrative of a social or cultural phenomenon (Creswell, 2015).

Research Questions

This qualitative study sought to understand the following research questions:

1. In what ways has Corona Division's organizational climate influenced the retention of women in the STEM career fields?
2. What motivates women in the STEM career fields to stay in their profession?

Research Design

This study sought to describe the experiences of women identified as high-grade STEM professionals at Corona Division rather than identifying the experiences of all women in STEM as a group. Using a qualitative phenomenological case study design allowed the researcher to explore the lived experiences that have resulted in these women achieving the high-grade level within the organization. Creswell (2015) described phenomenological research design as follows:

> Phenomenological research is a design of inquiry coming from philosophy and psychology in which the researcher describes the lived experiences of individuals about a phenomenon as described by participants. This description culminates in the essence of the experiences for several individuals who have all experienced the phenomenon. This design has strong philosophical underpinnings and typically involves conducting interviews (Giorgi, 2009; Moustakas, 1994).

The phenomenon of the study is the achievement of reaching high-grade career status as a woman STEM professional at Corona Division. As discussed in Chapter 2, in 2021, only 5.6% of Corona Division's total workforce were high-grades, and women made up 23.4% (26) of the 5.6%. Understanding how these women interpret their personal and professional experiences and the meaning they attribute to these experiences is why a qualitative research design is appropriate for this study (Merriam, 1998). Trinczek (2009) also argued that qualitative interviews were more advantageous to researchers than standardized survey methods because of their high degree of sensitivity associated with the interviewees' everyday lives and the respective structures of relevance orienting their actions and decisions.

A case study was the appropriate form of qualitative research design because it focuses on individual activities and experiences, rather than those of groups (Creswell, 2015). Merriam (1998) found that "case studies offer a means of investigating complex social units consisting of multiple variables of potential importance in understanding the phenomenon" (p. 41). The use of a qualitative case study provided an opportunity to offer a richly descriptive and in-depth understanding of the lived experiences of these women (Merriam & Tisdell, 2016). As further observed by Creswell (2015), a case study

is also an “in-depth exploration of a bounded system based on extensive data collection” (p. 469). The use of this methodology assisted in identifying common themes based on the lived experiences and strategies utilized by the study participants while advancing to high-grade status within the organization. The results of this study may provide a set of recommendations for women, men, and organizational leaders to enhance the advancement and development of women in the STEM career fields within government agencies. The location bound this study and the population studied.

Population

As shared in Chapter 2, as of October 2021, Corona Division comprised 1,963 government civil service employees with women making up 490 of the population. Of the 490 women in the organization, 209 were identified as being in the ND pay band and 277 were identified as being in the NT pay band. Women in the ND and NT pay band who have been identified as being a high-grade STEM professional made up the target population for this study. Although there is a large population of women within the organization, this study focused on the individual lived experiences of these women high-grade STEM professionals rather than a larger group to allow for a deeper level of understanding and insight. A target population is a group of individuals with common defining characteristics who can be identified and studied by the researcher (Creswell, 2015). Common factors included their gender as women, professional education within the STEM career fields, and their professional experience based on being identified as a high-grade within the organization. The target population for this study was Corona Division women high-grade employees located at either Norco, California; Fallbrook,

California; Seal Beach, California; or at the 14 field sites located throughout the United States.

Sample

Purposeful sampling was applied in determining the participants and the research sites for this study. When using purposeful sampling, the researcher intentionally selects individuals and sites to learn or understand the central phenomenon being studied (Creswell, 2015). The study sample from the population was originally intended to be the 12 women STEM professionals identified as being in a high-grade STEM or STEM+M position in Table 3. Of the 12 women determined to be part of the sample size, three of the women were removed from the original sample size because the researcher has a supervisor to a subordinate professional relationship with them. Once removed, the sample size consisted of nine women high-grade STEM professionals. Only eight of the nine women identified participated in the study. As observed by Merriam (1998), "purposeful sampling assumes that the investigator wants to discover, understand, and gain insights and must select a sample from which the most can be learned" (p. 61). As expected, the sample of women in the study ranged in various demographic categories, including age, ethnicity, and years of experience.

Although sample size depends on the qualitative design being used, the researcher intended to interview at least five women STEM professionals, which is greater than 51% of the sample size and is in the range of three to 10 individuals who generally make up a phenomenological study sample size (Creswell, 2015). Based on the unique experience of these women, elite interviewing was used for this study sample, which was formed through a purposeful homogenous selection of the participants. Homogenous sample

selection is conducted when specific sites or people are identified within the sample because they possess a similar trait or characteristic (Creswell, 2015).

Elite interviewing focuses on defined participants who are considered influential and well-informed by their colleagues based on their experience and expertise in the subject matter being researched (Marshall & Rossman, 1989). As high-grade STEM professionals within the organization, these women are recognized as highly technical leaders and STEM professionals in their specific disciplines. As Bogner and Menz (2009) argued,

> The expert should be seen as a person who disposes of particular competencies, and who consequently has a social status, or exercises a function, which places her in a position where she may be able to gain general acceptance for her action orientations and situation definitions. (p. 72)

Elite interviews provided the most in-depth understanding of the lived experiences of these women, which delivered the most relevant and impactful understanding and discovery of the research questions.

Elite interviews also assisted the researcher in narrowing the focus of the study to just Corona Division high-grade women STEM professionals. Although there are nine other NAVSEA Warfare Center Divisions located throughout the United States, expanding the number of study participants and the sample size would not provide an in-depth understanding of Corona Division's organizational culture's impact on the retention of women in the STEM career fields, if any. According to Creswell (2015), the number of participants in a qualitative study can range from one or two to 30 or 40; however, the larger the number, the greater probability of the study becoming unwieldy and resulting

in superficial perspectives. Focusing on just Corona Division aligns directly with Research Question 1. This sample and population size allowed the researcher to identify possible social or environmental factors concerning organizational culture and SDT extrinsic sources of motivation that high-grade women STEM professionals have experienced.

Instrumentation

A single organizational climate research instrument was used to conduct this research. This instrument was used following an initial organizational demographic screening to identify women in high-grade positions and classified as STEM professionals in the ND or NT pay bands as part of the organization's DEMO. The researcher used an organizational climate instrument developed by Dixit (2016) in his study of Asian Americans in the U.S. aerospace industry as a framework for his instrument. The researcher also mitigated any research bias by removing any potential participants who had a direct reporting relationship with the researcher. The initial demographic screen, similar to techniques used by Leedy and Ormrod (2001) and Dixit (2016), relied on personnel data provided by the Human Resources Office. Then the researcher used a script (Appendix A) to guide the originally scheduled 60 min face-to-face interviews. Here, the interview guide followed Creswell (2014b) by exploring the barriers, tactics, and strategies needed for these women's career paths. By using a guide (script), the researcher was able to stay focused on the volunteers' nonverbal cues, stay on track during the interviews, and allow the flexibility to explore the subject area throughout the discussions.

Before utilizing the instrument, the researcher received written permission from the original owner of the instrument to use and modify it in this research (Appendix B). Changes made from the original instrument used by Dixit (2016) included pen and ink changes. An example of these changes includes the following: changing "business" leader to "technical" leader; changing "company" to "organization"; changing "Asian American" to "women"; and removing some of the questions from the original instrument, which are not relevant to this study. As described by Dixit (2016), the open-ended interview questions (Appendix C) consist of two parts: (a) the warm-up questions about background, career progress, and motivation; (b) the specific questions about their barriers and enablers for career growth. According to Christmann (2009), "Exploratory interviews with experts and elites should be conducted as openly as possible, in order to make it possible to gather unexpected information and interpretations, which could have not been imagined when constructing the topic guide" (p. 13).

Interview Questions

A. Section One

Personal background, career progression, and motivation questions

1. Why did you choose to enter the science, technology, engineering, or mathematics (STEM) career field?
2. How has your career progressed so far?
3. What are your measures for a successful career?
4. What are your impressions of the qualifications and characteristics of a senior manager and leader in this organization?
5. Why did you want to be a "technical" manager (and/or a leader) in this organization?

6. Describe what, in your opinion, are the aptitudes and credentials required to be a successful manager/leader in this organization.
7. As a woman, what motivates you to remain in the STEM profession?

B. Section Two

Career barriers and enablers

8. Describe some of the barriers that you've faced in your career so far.
9. In the context of leadership aspirations, what are some of the barriers you've faced in joining the management or technical high-grade pool and in developing the required skills and attributes?
10. What are some institutional, environmental, or other enablers that have helped you in your career progression?
11. In your opinion, why are there so few women in high-grade positions or in the senior management/leadership ranks at this organization?
12. What, in your opinion, should be done by the individual (you) and by the organization (Corona Division) to enable more women to aspire to the leadership or technical high-grade ranks successfully?
13. Anything else you would like to add—as either prescription or as caution to colleagues with similar aspirations?

In-depth elite interviews were the instrument used for data collection. Based on the identified sample size, these were open-ended qualitative interviews with women STEM professionals in the ND or NT high-grade pay band. Elite interviews are successfully conducted when they include using open-ended questions, participants are flexible, and listening carefully (Dexter, 1970/2006). Interviews were digitally recorded

using an interview protocol. Once interviews were completed, they were digitally transcribed by a professional third-party company (Scribbie) to limit the researcher's unconscious bias or misinformation. Once transcribed, the researcher went through the transcripts and audio for each interview to validate that the data from the interviews were transcribed correctly and corrected any errors between the digital transcription and the original recording of the interview. The IRB approved the interview questions and process on January 12, 2022, as part of this study's IRB approval.

Researcher Interest

The researcher's interest in this topic developed from a career working in several engineering organizations within the Department of Defense over his 27 years in service to the United Stated government, including over 7 years with the U.S. Army Corps of Engineers and an additional 7 years with the NAVSEA Warfare Centers. Lipowski (2008) emphasized the importance of taking into consideration the researcher's personal lived experiences in the process of developing research questions for an area of study because they can assist in identifying gaps in the existing research. In these engineering organizations, the researcher worked with and was supervised by women STEM professionals. Both organizations reached milestones of having women as the senior leaders within the organization during his tenure. Although the researcher is not a woman and does not have a STEM undergraduate or graduate degree, he is interested in identifying how senior leaders and organizations can enhance the development and advancement of women in STEM organizations.

Trinczek (2009) argued the researcher should have expert status themselves to conduct successful expert interviews with managers as well as appear reasonably

comparable to and equal to the interviewee in respect to age and qualifications. The researcher is considered an expert in his field within the organization, has a graduate degree in his career field, and has over 27 years of leadership experience. He also completed the Collaborative Institutional Training Initiative (CITI) training for human subjects research. For this qualitative study, the researcher completed the Social-Behavioral-Educational Researcher Course, which provides an introduction and focuses on protecting human subjects when conducting research.

Data Collection

Following the Institutional Review Board (IRB) approval to conduct this study on January 12, 2022, the researcher began to coordinate the collection of his research information using qualitative elite interviews with women STEM professionals with whom the researcher did not have a professional direct reporting relationship within the ND or NT high-grade pay band. As of 17 January 2022, nine women met this criterion, and the researcher reached out to them using email communication to inform them of the study, its purpose, how they were selected to be in the study (based on their position being identified in the STEM career field, high-grade status, and gender), and asked them to complete their consent form (Appendix D) within 2 weeks if they would like to participate in the study. The nine potential participants were notified that there were no foreseeable risks from their participation in the research and that they could end their participation at any time without needing approval from the researcher or organization. Although all participants who returned the consent form fully participated in the research interviews, had one of them decided to stop the participation, the data collected would not have been included in the data analysis or research findings.

Before contacting potential study participants, the researcher received approval from the organization, Corona Division, to contact potential participants. In accordance with Secretary of the Navy Instruction 3900.39E, which guides human subjects research within the Department of the Navy (DON), "when the research is supported by the DON and the targeted subject population consists of DoD personnel, written DoD institutional permission is required before the research can begin" (Secretary of the Navy, 2018, p.10). The researcher used his collegiate email and not his official Navy email to contact participants because the research supports academic research and was not considered to be official DON research. In addition to notifying the nine potential participants of the Command's approval (Appendix E) to conduct the research, the researcher also included attachments to the email, which consisted of the following: a copy of the organization's approval to conduct the study, a formal letter of introduction, the participant informed consent form that also provided consent to audio record the interview and a confidentiality statement, and the research participants Bill of Rights (Appendix F).

This research was conducted on the participant's own personal time, including the researcher's time. The researcher let the potential participants know that payment would not be provided for their voluntary participation. He also notified potential participants that he was available to answer any questions they may have had before, during, or after the interviews. To mitigate against potential candidates having scheduling conflicts that could emerge and to maximize participation, the researcher sent follow-up emails a week after the initial email contact with the nine potential participants and follow-up emails 4 days, 2 days, and 1 day before the 2-week suspense. Because this was what Glesne and Peshkin (1992) defined as "backyard research," the researcher verified that he was not in

a superior supervisory role with any potential participants and removed the participants he did have a superior supervisory role with from the study sample.

The researcher needed at least five participants to achieve a 51% sample representation. This sample representation was exceeded within the 2-week timeline with eight of the nine potential participants returning their signed consent forms. Had the research not received at least 51% participation, he would have sent out an additional reminder email requesting participation and informing participants of the need to achieve a 51% or greater sample representation. Because the researcher achieved an 88.8% sample representation, he contacted each participant individually with potential interview dates and times based on the eight study participants who returned their digitally signed informed consent form. The researcher scheduled a maximum of three interviews per day. The interviews were organized in 90 min calendar blocks and intended to be 60 min long to allow for in-depth discussion. To mitigate research fatigue, the researcher set a minimum of an hour between the end of one interview and the beginning of another. One day, the maximum number of interviews, three per day, was scheduled, and the researcher conducted one interview in the morning, one around midday, and one in the afternoon. In addition, the researcher designed interview days so that they were a day apart from each other.

The researcher provided the study participants with the 13 interview questions several days in advance of the interview so they could review them and prepare their responses and gather their thoughts regarding their lived experiences. The researcher also contacted participants the day before the interviews to verify that no schedule conflicts had emerged. Only one interviewee needed to reschedule because of an

emergency, and the researcher was able to reschedule her interview with no issues. On the dates interviews were scheduled, the researcher was online and in the virtual face-to-face meeting room 15 min before the start time of each interview to ensure the video was working and the audio recording was coming through clearly. All the participants arrived on time and were well prepared, which caused several interviews to exceed the planned 60 min interview time and the 90 min calendar block. If study participants had not arrived in the virtual meeting room within 5 min after the start time, the researcher would have contacted them via email. After 15 min, the researcher would have also rescheduled the interviews with the participant. A maximum of two interview reschedule dates would have been established before the participant would have been excluded from the study if the 51% or greater sample representation had been achieved. This limit on the number of rescheduling times would have been necessary to allow the researcher to conduct his data analysis and present his findings on time. If the researcher had less than a 51% participation in the study, he would have continued to schedule and conduct interviews until at least a 51% representation was achieved. As previously mentioned, the researcher had an 88.8% sample representation and only needed to reschedule one interview, which had a minimal impact on the interview schedule for all participants.

To support the credibility of this study, in-depth and open-ended interviews, as well as journaling by the researcher during the interviews, served as the primary form of data collection. Although there is not a guarantee that researchers will be able to be balanced and fair in their data collection, a reflective journal is a method of using checks and balances to limit researcher bias (Lincoln & Guba, 1985). Data collection through these open-ended qualitative interviews began 3 weeks after initial contact with potential

participants and was conducted over 4 weeks in a virtual face-to-face setting. A virtual face-to-face social platform, Microsoft Teams, was used as the setting to mitigate potential concerns with in-person interviews during the Coronavirus pandemic, which began in 2019 and was ongoing during the research period.

To achieve at least a 51% representation of the sample, a minimum of five interviews needed to be conducted with a maximum of nine interviews for the researcher to achieve 100% sample participation. The researcher conducted eight interviews with an 88.8% sample participation. Open-ended interview questions were developed to allow the interviewees to elaborate and expand on their experiences during the interview. To enable the researcher to focus on the interview, the interview protocol consisted of interviews being recorded and then digitally transcribed through a third-party source to minimize any potential unconscious bias while conducting the interviews. Data saturation was reached based on content available and when there is no new data, no new themes, or new coding to be found following the data collection and analysis. For this study, the average interview time among the eight participants was 95 min, with 760 min of audio recordings captured. From these recordings, 177 pages of data were transcribed in Times New Roman, 12-point font, and single-spaced. As an observation protocol, the researcher also captured descriptive notes and reflexive notes separately to have the opportunity to capture multiple observations during the interview (Creswell, 2015). As Polsky (1967/1998) discovered, "successful field research depends on the investigator's trained abilities to look at people, listen to them, think and feel with them, talk with them rather than at them" (p. 119). The researcher followed the approved IRB protocol to conduct in-person interviews with participants.

Data Analysis

According to Creswell (2015), researchers should use six steps to analyze and interpret qualitative data to include: "preparing and organizing the data, exploring and coding the database, describing findings and forming these, representing and reporting findings, interpreting the meaning of the findings, and validating the accuracy of the findings" (p. 235). Once interviews and data collection were completed, data analysis began. The interview data were initially transcribed by a third-party transcription company (Scribbie) and then reviewed against the original audio recordings to validate study participant responses were accurately transcribed. Once validated, the data were analyzed and coded using an iterative process of coding the data through multiple reviews of transcripts, audio recordings to listen for changes in tone or inflection or to capture a study participant's emotions in a response, and research notes were taken during the initial interviews to identify common themes by each study participant's lived experience. Study participants were assigned an alphanumeric code by the researcher, such as SP1 (Study Participant 1), SP2, SP3, and so forth, to protect participant identities. Participant names will never be made public, and all identities remained confidential. All information linking back to an individual has been removed and was only known by the researcher for purposes of the study. The researcher destroyed all electronic and paper documents 5 years after publishing the study by shredding paper documents and deleting electronic files. This protection of the participants' identities ensured the privacy of all potential candidates.

All audio recordings were digitally transcribed and then verified verbatim against the original interview audio recordings to ensure complete reliability of the data. This

resulted in 177 pages of data captured from the interviews. Although the interviews were digitally transcribed, the data were coded manually to identify common themes and capture them to get a sense of the whole and assign meaning to each section of the interview data (Creswell, 2015). The coding process was iterative and resulted in filtering out the original data from the interviews by 65% to capture the themes from the responses through the coding process. The data were then further coded to an additional 45% reduction to capture key terms and clustered together to form common themes. Once the interviews were complete and the information was logged and coded for common themes, the themes were used to answer the research questions. Through this process, the researcher identified significant patterns and drew insightful meaning from the collected data to build a logical chain of evidence. This chain of evidence and themes, gathered by grouping similarly coded data from participant's interviews, formed the central ideas and findings of the research (Creswell, 2015). The research questions were designed to learn what ways Corona Division's organizational climate influenced the retention of women in the STEM career fields (Research Question 1), and what motivates women in the STEM career fields to stay in their profession (Research Question 2). Secondary data discovered during the research may provide an opportunity for future or further study.

Limitations

As a limitation, the research findings from this study are specific to the organization explored, Corona Division. The results of this research will not represent a more generalized population of leaders within the DoD or Navy nor of the other nine NAVSEA Warfare Center Divisions. Still, the findings will inform Naval Surface

Warfare Center Corona Division employees at all levels, current and future leaders of any identified gender, and women leaders and high-grades who participated in the study. In addition, not all women STEM professionals could be part of the study because of the number of women STEM professionals throughout the organization and the time constraints associated with completing the research. This research only included women STEM high-grade professionals and did not include STEM professionals in other genders or women in non-STEM professional career fields. The research location was bound to Corona Division employees who are located at Norco, California; Fallbrook, California; Seal Beach, California; and at the 14 field sites located throughout the United States.

Summary

This qualitative study used a phenomenological case study design to understand women's experiences as STEM professionals at Corona Division. The purpose of the study was to examine how women STEM professional have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts, if any, can be attributed to organizational culture. Purposeful sampling and open-ended interview questions were used as the primary forms of data collection. Interviews were then transcribed digitally and coded through an iterative process to capture the themes from the responses. The data were then further coded to capture key terms and clustered together to form common themes to assist the researcher in answering the research questions.

CHAPTER 4: RESEARCH, DATA COLLECTION, AND FINDINGS

Overview

This chapter presents the research and data collection process and findings from the study conducted after obtaining expedited research approval from the California Baptist University IRB. The application for expedited approval was sought because the researcher was using an anonymous survey questionnaire by which responses could not be linked back to the participants, all participants were adult volunteers and could opt out of the survey interviews at any time in the process, there was no more than minimal risk to participants, no deception was being utilized in the research, and there were acceptable consent procedures and documentation in place to include data and privacy protection. The eight interviews conducted with women high-grade STEM professionals were audio-recorded, and all personal identification information was stripped to maintain the confidentiality of study participants.

This chapter reintroduces the purpose of the study and two research questions, describes the research methods and data collection procedures used, and presents a summary analysis of the data and themes captured from the 13 open-ended qualitative interview questions. In the research methods and data collection procedures section of this chapter, the process used to refine over 175 pages of transcripts from eight individual interviews to discover the codes and themes from this study is described in detail. Coding was an iterative process, with each step filtering the data and gathering the keywords and thoughts from participant responses to form a common or central theme. Multiple manual analyses and coding levels were conducted, including open coding, selective coding, and thematic coding. Throughout the coding process, in-depth analysis

and comparison of the study participant's responses were validated to ensure critical terms, ideas, or thoughts were not lost through data filtering. Lived experiences shared with the researcher during the qualitative interviews are periodically shared verbatim to emphasize key themes and differing perspectives or support the analysis findings by the researcher.

Purpose Statement

This study sought to understand how women STEM professionals have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts, if any, can be attributed to organizational culture. A qualitative phenomenological case study was utilized to understand the study participants' lived experiences. Qualitative research provides an opportunity for the researcher to develop a holistic and rich narrative of a social or cultural phenomenon (Creswell, 2015).

Research Questions

This qualitative study sought to understand the following research questions:

1. In what ways has Corona Division's organizational climate influenced the retention of women in the STEM career fields?
2. What motivates women in the STEM career fields to stay in their profession?

Research Methods and Data Collection Procedures

Qualitative, open-ended interviews with eight women high-grade STEM professionals were conducted to gain insight into their lived experiences and assist the researcher in identifying intrinsic and extrinsic sources of motivation within SDT and the impact of SET on the participant's lived experiences. SET and the intrinsic motivation

factors under SDT are specific to the individual (self). Extrinsic SDT motivation factors, including social and environmental factors, are particular to the organization (environment). The study sample from the population was initially intended to be the 12 women STEM professionals identified as being in a high-grade STEM or STEM+M position as identified in Table 3; however, three of the women were removed from the original sample size, because the researcher had a supervisor to subordinate professional relationship with them, and one potential participant did not respond to the initial and follow-up requests to participate in the study. As high-grade STEM professionals within the organization, these women are recognized as highly technical supervisory and nonsupervisory leaders in their specific disciplines. Based on their positions within the organization and recognition as subject matter experts in their field of study or career field, elite interviews provided the most in-depth understanding of the lived experiences of these women. When conducting qualitative interviews with senior managers and elites, access to them can become a challenge; however, as Adler and Adler (1987) discovered, a small number of subjects, between six and a dozen, can be extremely valuable and represent adequate numbers for a research project. Conducting elite interviews delivered the most relevant and impactful perspective and discovery of the research question responses from these participants.

Video and audio recorded individual interviews were conducted to explore the motivations, lived experiences, tactics, and strategies implemented by these women to be successful in their career paths. As Weller (2015) discovered,

> Interviews via Skype seem to be a better solution than telephone interviews if face-to-face interviews cannot be conducted due to time restrictions or budgetary

> reasons. As there is a virtual visual presence of the interview partners, the interview situation can be better controlled (on both sides). Given the target groups of expert and elite interviews it can be assumed that many of them are familiar with using recent technical devices; the younger generation more than the older. Thus Skype interviews will likely become more important in the future. (p. 15)

These interviews provided the opportunity for participants to share with the researcher any insight for colleagues with similar aspirations to consider regardless of gender identification. In-depth elite interviews were the instrument used for data collection. Based on the identified sample size, these were open-ended, qualitative interviews with women STEM professionals in the ND or NT high-grade pay band. During the interviews, the researcher realized that not all study participants were scientists or engineers, so he needed to reframe question number one to ask why participants chose to enter the science, technology, engineering, or mathematics (STEM) career field instead of just the science and engineering career fields. Table 4 identifies which of the STEM career fields each participant aligns with as well as their highest level of education and position type. Study participants had an average of 4 years in their current high-grade role, and 20.5 years at Corona Division. The least amount of time any of the study participants had been in their current role was less than 1 year, and the greatest amount of time was 8 years. The same amount of time, less than 1 year, was identified for the least amount of time a study participant had been with Corona Division, with the longest amount of time being 37 years.

Table 4

Study Participant Education Level, STEM Degree Type, and Position

Subject	Education level	STEM degree	Position
SP1	Master's degree	Engineering	Supervisor/manager
SP2	Master's degree	Science and technology	Technical high-grade
SP3	Master's degree	Engineering	Technical high-grade
SP4	Bachelor's degree	Engineering	Technical high-grade
SP5	Master's degree	Science and mathematics	Supervisor/manager
SP6	Master's degree	Engineering	Supervisor/manager
SP7	Master's degree	Engineering	Technical high-grade
SP8	Bachelor's degree	Science and technology	Technical high-grade

The researcher needed at least five participants to achieve a greater than 50% sample representation. A 51% or greater sample representation brings validity to the research findings by ensuring the majority of the sample size is represented in the study. For this study, the researcher achieved an 88.8% sample representation with eight of nine possible participants participating in the study. To support the credibility of this study, in-depth and open-ended interviews, as well as journaling by the researcher during the interviews, served as the primary form of data collection. Open-ended interview questions were used to allow the interviewees to elaborate and expand on their experiences during the interview. To enable the researcher to focus on the interview, the interview protocol consisted of interviews being recorded and then digitally transcribed through a third-party source to minimize any potential unconscious bias while conducting the interviews. For this study, the average interview time across the eight participants was 95 min, with a total of 760 min of audio recordings being captured. From these

recordings, 177 pages of single-spaced data were transcribed using Times New Roman, 12-point font. As an observation protocol, the researcher also captured descriptive notes and reflexive notes separately to have the opportunity to capture multiple observations during the interview (Creswell, 2015).

Once the interviews and raw data collection process were completed, the analysis of the raw data began. According to Weller (2015), because "there is no standard procedure for analyzing expert interviews, in principle, all qualitative social research analysis methods can be used" (p. 16). The interview data were initially transcribed by a third-party transcription company (Scribbie) and then reviewed against the original audio recordings to validate that study participant responses were accurately transcribed. This cleaning and validation of the data were essential in ensuring key terms, ideas, or thoughts provided by participants were not lost or misinterpreted through the audio transcription process. Once validated, the data were analyzed and coded manually using an iterative process of open, selective, and thematic coding. This coding and analysis process consisted of multiple reviews of transcripts, audio recordings to listen for changes in tone or inflection or to capture a study participant's emotions in a response, and research notes taken during the initial interviews. This was then used to identify common themes by each study participant's lived experience.

In the first stage of coding, open coding was used to analyze and assess each study participant's responses individually. As described by Urquhart (2013), this phase of analysis was completed by coding each line of transcribed interview text and using as few words as possible to describe the data or identify key words from the data. Although this process was extremely time consuming, it was invaluable for the researcher in getting

an in-depth appreciation and understanding of the lived experiences of these women pioneers and trail blazers at Corona Division. Open coding can also become overly data driven because researchers can find themselves identifying codes or potential themes that are not relevant to the study but may help to inform future research. Having the research questions as the focus helped to mitigate coding creep, in which codes grow exponentially and do not have a focused purpose or do not have a correlation to the research questions or study's purpose.

Completing the open coding process helped the researcher transition to selective coding of the data. This process also made the data more manageable for the researcher to analyze. Through the open coding process, commonalities began to emerge among study participants, which formed the basis for the selective codes and following themes that began to emerge from the data. Through the iterative coding process, a single selective code can become a prominent theme for the study (Birks & Mills, 2011; Urquhart, 2013). Although several categories began to emerge, there were far fewer selective codes than open codes, which validated to the researcher that the coding process was being properly implemented as intended to discover the core themes in the data.

The coding process was iterative and resulted in filtering out the original data from the interviews by 65% using an open coding process. This assisted the researcher in beginning to identify themes from the responses through the coding process. The data were then further refined to an additional 45% reduction through selective coding to capture key terms that were clustered together to form common themes using thematic coding. Once the coding process was complete, the information formed common themes which were used to answer the two research questions in the study.

Presentation and Analysis of Data

There were 13 open-ended, qualitative questions asked of study participants (SP). The questions were placed in two groups to allow for a natural break in the conversation while enabling an enhanced flow and focus during the interviews. This allowed the researcher to use the same script of questions while allowing the participants to answer the questions candidly (Dixit, 2016). Questions 1 through 7 were designed to determine individual backgrounds, motivations, and characteristics with responses presented as a word cloud in Figure 7. These questions assisted the researcher in answering the second research question: "*What motivates women in the STEM career field to stay in their profession?*" Questions 8 through 12 were designed to shift the conversation to institutional topics and participants' perceptions about enablers and barriers in their careers. These questions primarily assisted the researcher in answering the first research question which asked, "*In what ways has Corona Division's organizational climate influenced the retention of women in the STEM career fields?*" Questions 8 and 9 examined barriers and Questions 10 through 12 looked at enablers as depicted in the word clouds in Figures 8 and 9. Question 13 provided an opportunity for study participants to share any additional insight that may not have been asked during the interview process, that they may have thought of while reflecting and preparing for their interview, or during the interview process. A word cloud generator (https://monkeylearn.com) was used to capture common words used by the study participants for each of the interview question areas.

Figure 7

Word Cloud for Questions 1-7

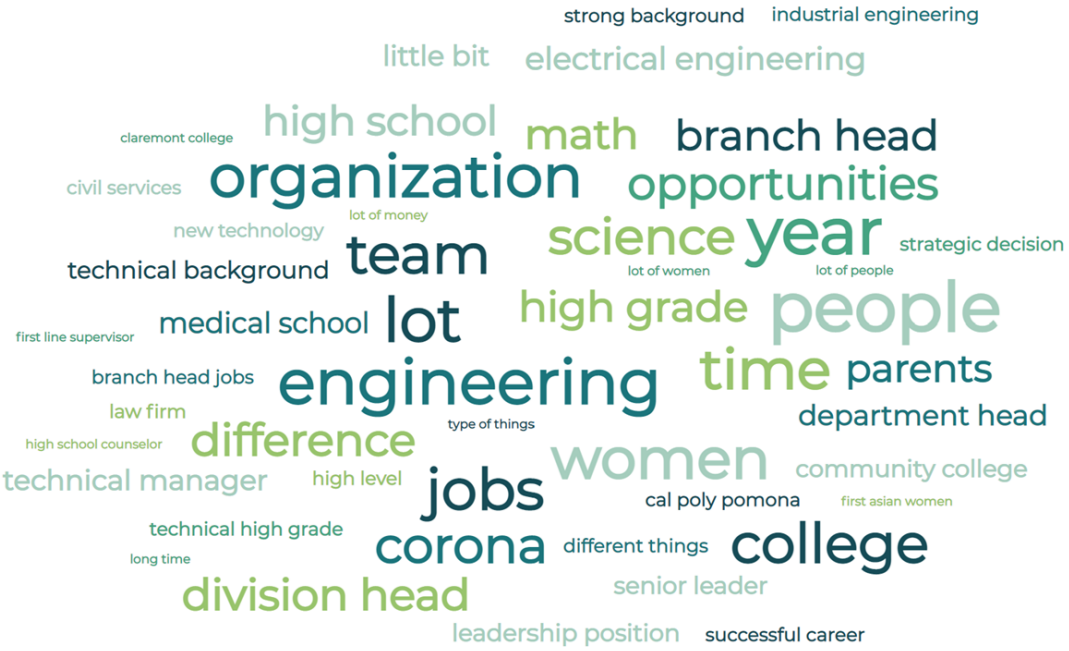


Figure 8

Word Cloud for Questions 8-9

Figure 9

Word Cloud for Questions 10-12

Interview Question 1

Why did you choose to enter the science, technology, engineering, or mathematics (STEM) career field?

This question aimed to ascertain initial professional aspirations and allowed the participants to share some of their early personal background information regarding the start of their journey in the STEM career field (Dixit, 2016). Interestingly, only 50% of participants went into their undergraduate studies wanting to work in the STEM career field they ultimately pursued and established their professional career in. One participant wanted to be a lawyer or author, another a nurse, another a medical doctor, and another wanted to pursue a career in sociology; however, they transitioned to a STEM career field along their undergraduate education journey. The following responses from two study participants summarize the general sentiments of the participants who went into college pursuing a STEM career field. SP3 stated,

> I've always been into science and math, so once I found out that you could be in a career, other than a math teacher or a science teacher, where you could incorporate those types of things, I was like, oh, okay, I think engineering is for me.

SP7 stated,

> As a child, it was a natural progression that I would gravitate towards engineering. I wanted to be part of the generation that made the technologies that enabled space travel and new technologies—as reflected in popular movies like *Star Wars*, *Battlestar Galactica*, *Buck Rogers*, *Close Encounters*, and *ET*—come true.

Although the specific participants differed, the same percentage of participants, 50%, pursued or transitioned to a STEM career field for the money. Several realized that they needed a career that would be able to provide the level of financial freedom they wanted in their lives. This financial freedom resulted in both intrinsic and extrinsic motivators for this group of women. The intrinsic sources of motivation, autonomy and individual competence, have a strong correlation to SET. These also are two of the three psychological components under SDT. Financial stability served as the extrinsic source of motivation for these women in their decision to pursue a STEM degree and professional career.

SP1 discussed financial stability and autonomy:

> I knew this was my only shot, so it was now or never. I had no second opportunities. I had no additional money to pull from and I had to stand on my own two feet. I knew when I got out (of college), I had to be able to get a job and

> stand on my own. That's what kept me going. I knew, even if I didn't like it, I couldn't switch (undergrad majors) at that point, because that would take extra years in school if you switched (degrees) halfway in. I only had money for 4 years.

SP4 discussed financial stability:

> I had to pay for school. My parents paid for all of my community college, and so I took out a loan and needed to pay for school. Money was a motivator since there was a big gap in pay between what a physical therapist could make compared to a computer scientist.

SP5 discussed financial stability, autonomy, and competence:

> I'm from nothing. Having a career that is respected, where I could earn a lot of money, and there would be no question of intelligence or anything like that, is what I wanted. I didn't want to struggle anymore.

A common theme across all study participants was the high levels of support they received from family, friends, and school/program sponsors. Seventy-five percent of study participants talked about being encouraged to pursue a STEM career by people they respected or trusted. The following are two different extrinsic sources of motivation (family and friendship) examples tied to the SDT relatedness psychological component that was consistent across study participants for choosing to pursue a STEM career field. SP4 stated, “The first part was cultural motivation, or culturally directed by my background, and to please my parents. We are taught to go into a field or profession in medicine, science, or engineering.” SP8 stated,

> As a refugee from another country, I'm the first one to go to college within my family. I discovered that I was really good at math at a very early age in school, and I knew that my career path would have something to do with the scientific field. I was very fortunate in high school to become friends with someone who was just like me, who was a woman too. We both thought computers were cool, so we went to college and both earned our degrees in computer information systems.

Interview Question 2

How has your career progressed so far?

The purpose of this question was to begin the study participants' introspection regarding their choice of careers and also choices, aspirations, and results of their career efforts (Dixit, 2016). Overwhelmingly, all the study participants felt that their career far exceeded where they initially thought it would go. As an example, several study participants aspired to be a team lead, technical high-grade, or a department head. It is interesting to note that all these individuals either achieved or surpassed these aspirational goals. The extrinsic sources of motivation (organizational impact and relatedness) as well as intrinsic sources of motivation (autonomy, competence, and purpose) shared in the responses provided by two of the participants who summarized the common perspectives shared by the study participants when answering this question. SP2 stated,

> I started as a contractor, joined civil service as a GS-5/7, then took a break in civil service and went to industry for 4 months. Then I came back into civil service as a GS-11 and picked up G-15 when I was 37. Do I go pursue SES (Senior Executive Service) somewhere? I think maybe 5 years ago, 4 years ago, that

answer was probably yes. Not that I would be opposed to it, but I've got so much work to do in my current role, and to really transform the program that we're managing on behalf of our sponsor. I think the satisfaction doesn't come from having a more senior-level role, it comes from seeing this program really mature.

SP6 stated,

> I love the organization I work for. I believe in the mission, working for the Navy, and contributing to our country. I think that plays a large role in being successful. To get to work in an environment that you really love, and you can make an impact and contribute. I feel that I'm doing that in my current position.

Statements like "better than I could have imagined" (SP1), "I'd say a lot further than I thought it would go" (SP3), "I'm pretty happy how it's gone. I didn't think I would ever have the opportunity to be a high-grade" (SP4), and "the division head job I'm in now is tremendously rewarding" (SP5) support the common theme of how this group of women feel their careers have progressed. Each participant shared how they not only had a high level of self-efficacy in their ability to perform the responsibilities expected of their position, but also felt like they were making a positive difference in the people and organizations that they support.

Interview Question 3

What are your measures for a successful career?

This interview question was meant to have the participants define their meaning of success and reflect on their earlier answer to Question 2 regarding career progression. The intent was to have the participants tie their career journey so far with what they believe success is (Dixit, 2016). Making a positive impact on the organization and others

was the overarching theme of the responses to this question. SP2 summarized the general extrinsic motivation sentiment of the group by stating that she measures a successful career as

> what I leave behind in enabling cultures to build from the changes that I've influenced. I note that I said influenced, and not made myself, because it's not about me. It is about the team and the folks doing the work.

SP5 provided an intrinsic motivation perspective to measuring a successful career by

> being in a position where I have some autonomy, where I have the responsibility, where I can make decisions, and where I don't get micro-managed. And I make enough money to where I have a good living, buy what I want, and don't have to worry about whether I have enough money for groceries.

Interview Question 4

What are your impressions of the qualifications and characteristics of a senior manager and leader in this organization?

This question began to probe the participants' outward views of success; in this case, to reflect on the behaviors and qualifications of the people who are organizationally senior to them in career rank or progression (Dixit, 2016). The SDT psychological component of competence, specifically having, displaying, and sharing technical competence was an overarching theme from many study participants. As Bottomore (1993) argued, "Experts are considered to have outstanding cognitive abilities, and the societal acceptance of their authority is highly dependent on their performance" (p. 6). Because the women interviewed were all from technical STEM career fields, it makes sense that technical competence was a strong response to this question. Displaying

humility and creating a supportive environment where individuals can work through problems individually or as a team were also common themes along with empathy. The following participant responses summarized the general sentiments of the group. SP6 stated,

> I think one of the things I learned as an ND-5 division manager, that's different from where I was as a branch head or an engineer, is that I've always stepped in and did it when somebody was in trouble. As a division head, that's not your place to go and do it. Your place is to help enable others and help guide them so they can do it and be successful. That was a whole different perspective, and I had to learn that skill because it was so much easier for me to just go do it, but I had to step back and say, "No, not my role. My role is to help enable." So, I learned how to do that, and I learned to do it well, train others, mentor them, guide them, and help them be successful, so they can grow and be successful in their jobs. I think that is a very important part of being a technical manager in today's organization, in our organization.

SP8 stated,

> Demonstrating a high level of leadership, managerial, and interpersonal skills. This not only includes their communication skills, but they need to also empathize with others well. Successful managers manage and lead and understand their subordinates and those outside of the organization while supporting a high level of freedom, which can go a long way to improve the attitude and morale of the team.

In addition to these two perspectives, SP3 provided insight on the importance of being approachable and friendly as a leader and the impact not being so has on others as an extrinsic source of motivation:

> Some not great impressions experienced has been people who have been here a million years and are set in their ways and not very personable. I feel like the best leaders are people who speak to you.

Interview Question 5

Why did you want to be a "technical' manager" (and/or a leader) in this organization?

This question was intended to help identify the participant's purpose and perceived impact as a leader in the organization. Two major themes emerged from the responses to this question. The first theme was the desire to make a difference to others and the organization. This desire to make a difference is supported by the SDT intrinsic sources of motivation and SET by these women not only having a desire to make a difference but also believing that they can make a difference. This belief that they can make a difference within the organization and future generations was best highlighted by the response from SP7, which summarizes this first theme:

> I wanted to build a solid foundation or at least modernize the foundation in the division. I wanted to make a long-lasting positive impact on the division, I wanna help shape the next generation and educate them in areas I felt were lacking when I was coming up through the ranks, and I think that as a technical manager for a large federal agency, you have a lot of opportunities to do good. Still, it takes a lot of persistence and a lot of hard work.

The second theme that emerged was the desire to challenge themselves and make strategic decisions. This theme incorporated the SDT internal source of motivation by describing the importance of being challenged in new ways that grow an individual's competence in a given field or subject. It also highlights the desire to feel like part of the team that has the autonomy and trust of the organization and its leaders, to make strategic and impactful decisions. This desire aligns with the SDT extrinsic source of motivation of relatedness by the individual within the organization or team. The responses provided by SP3 and SP7 best supported this theme. SP3 stated, "It challenges me in different ways and forces me to think more strategically and grow, and I like that." SP7 stated,

> That was always my goal. To become a technical leader, I wanted to be at the forefront of innovation. That's what kind of tickles me. I want to be part of that team sitting at the front table and making those strategic decisions and taking us into the future.

Interview Question 6

Describe what, in your opinion, are the aptitudes and credentials required to be a successful manager/leader in this organization.

This question further probed participants' personal career desires and tied with Question 4 to discover what it actually took to successfully climb the organization's ladder (Dixit, 2016). Typical responses from study participants related to intrinsic sources of motivation and having specific knowledge, skills, and abilities like "leading by example," "technical competence," "communication and people skills," "empathy," "decision-making abilities," "hard working," "commitment to the mission," and "taking personal responsibility." Bottomore (1993) argued that "experts can be understood as

people who possess specific knowledge that relates to a clearly demarcated range of problems and plays an authoritative role in decision-making of different kinds" (p. 5). The responses from SP7 and SP8 best summarize the theme of the group. SP7 stated, "They should be able to explain complex concepts to a novice. If you can't do that, it's no use if you can't articulate the knowledge you have." SP8 stated,

> We should understand our authority and delegate responsibility and authority when appropriate. We don't have to do everything ourselves. We should be able to make hard decisions and face problems and make appropriate changes. We have to coach and counsel teams for effectiveness and plan for our own development while investing in others.

Interview Question 7

As a woman, what motivates you to remain in the STEM profession?

This question directly aligns with the second research question for this study. It was intended as a validation question of the responses received in Question 1 through Question 6. It captures any potentially new perspectives from the study participants' motivation factors that they had not shared previously. The responses from SP1 and SP2 provide an overarching theme to the view shared by study participants regarding the first part of this question. Several study participants were visibly and vocally offended by this question, specifically with the question beginning with their gender as the initial focus. Although not intentional by the researcher, it was interesting to see the participant's responses align with both intrinsic and extrinsic sources of motivation and their wanting to be seen as a professional in the STEM field rather than a woman STEM professional. Including their gender as part of the question was communicated to be unnecessary by the

study participants and something that the researcher observed as a response that participants felt questioned them along with the three psychological components of SDT: autonomy, competence, and relatedness. SP1 stated,

> I wouldn't say “as a woman” because I think this is related to anybody who stays in the science and engineering field, and quite honestly, I don't think just because I'm a woman, I’m any different. The only difference between a woman is we can bear children. You can have a baby.

SP2 stated,

> I don't know if I don't acknowledge it for myself or project it as a woman. I'm a woman in this leadership role. I'm a woman in technology. I'm a woman in a leadership role in technology. I typically don't put them all together, but as just a career professional and someone passionate about what I do, regardless if I am a woman or identified as something else, it's just the contribution and the opportunity. My goodness, the opportunity is endless in what we do and specifically in this organization.

Once the gender component of the question was addressed, the motivation to stay in the STEM field included the study participants wanting to work in the career field they went to school for, loving their career, and wanting to be respected as a professional. The consistent theme that emerged for the motivation to remain in the STEM profession was that these women love being in the STEM field. They genuinely enjoy their work, and if they didn’t, they would do something else. This perspective supports their high self-efficacy and belief that they can shift careers if desired. The response from SP3 highlights this and the importance of being that silent role model for others whether

knowingly or not. In addition to the response from SP3, the reply provided by SP4 highlighted an additional theme that emerged from this question, the ability to be seen as a professional regardless of gender. The response from SP5 was also insightful while reminding the researcher that this was the career field she wanted to be in, so why would she not work in the STEM field.

SP3 stated,

> Well, I enjoy it. And also, to represent, it makes a difference to see someone who looks like you doing something that you don't usually see. It does make you think like, "Hey, I can do that. Like, yeah, I can do it." And there's not a lot of women in STEM, there's not a lot of women who pursue math or science, and I don't know why, but I know that just me being here, I can make a difference to some girl who is like, "Hey, you know, she did it. Maybe I could do it too." Yeah, you know, you could do it. And that's my goal. I want to see more females and people of color going to the science and engineering fields.

SP4 stated,

> For the technical community to realize and look past our gender and see that we have the same capabilities as our male counterparts with intellect, decision making, and assertiveness. To demonstrate that we aren't making decisions based on emotions as a female. It's actual critical thinking.

SP5 stated, "I've got a scientific degree, so I need to work in the field where my education is."

Interview Question 8

Describe some of the barriers that you've faced in your career so far.

The question focuses on general work experience barriers study participants have experienced, such as their career aspiration experiences that are the focus of Question 9 (Dixit, 2016). The study participants were honest and open with the researcher about some of the barriers they experienced in college, industry, and federal government, including Corona Division. Several times participants shared statements like, “but he retired, so it’s better now,” “this was early in my career,” or “it’s not like this anymore.” These barriers highlight some of the detrimental or challenging organizational factors that impacted the study participants' self-efficacy and caused them to question their intrinsic sources of motivation. Although some are listed here, the researcher is purposely not tying the responses to any specific participant to protect their privacy:

- Being told that I was not selected for a position because I was a young female engineer.
- Walking into a room and people right away discarding my presence as not being credible because I am a female and not a 50-year-old White male.
- I had to work extra hard to prove myself because a barrier was intentionally placed in front of me. So I had to get creative, think differently, or establish a professional relationship to show my worth in the organization.
- Here are your steel toe shoes, and they're pink, which I hate pink. I enlisted one of my division managers in my last government role, and we colored in all the pink piping black on my stupid hand given steel toe shoes because I was a girl. I must want those because I'm a girl, I must want pink post-it notes and pink pens, and I hate the color pink. Hence, I threw it all in the trash, but I had to go to meetings and walk across the base in these hot pink and black

stupid steel-toe shoes. I'm like, I'm sharpieing *[sic]* these things out because I don't want to stick out like a sore thumb, but it was almost like, I don't know if it was intentional or unintentional, but divide. We're going to make sure that you do not fit into this environment, and I think it was just like second nature because women weren't respected in the same way that men were.

- I've been on emails and in meetings where “gentlemen” has been used to address the group.
- I've had to put people in check for calling me emotional, and it's not fair because if a man blows up, he's just him, like, “Oh, that's just how he is,” but if I blow up, oh, I'm being emotional. Well, why isn't he being emotional? Why is it different? Why do I have to be characterized as something because I get upset?
- I have to watch how I react, whether right or wrong, because you get labeled as this type of person just because you're a female.
- I have had a lot of situations like that where people have been nasty to me, or they didn't feel they had to respect me, or maybe didn't know what my level was. I would continue to show them respect, and it would break that wall down, and now all of a sudden, they're treating me with that same manner of respect, so that's been one strategy I've implemented that I've seen work, but I don't know if it's a one-size-fits-all solution.
- In college and my professional career, I did experience some sexual harassment.

- When I first started, I sat right next to my supervisor. There were a lot of assumptions from people in outside branches or other divisions that would visit my supervisor. They always assumed I was his personal admin because I was the only female in the branch, so I have tough skin, and it didn't bother me. I just took it as a joke.
- Discrimination, not necessarily just from males, but from females too, when it comes to work–life balance. When you're growing as a family, there's that discrimination about, "Well, it must be nice to take maternity leave and not do anything."
- I've felt negative bias and doubts about my capabilities because I was female, and I have felt it based on my ethnic background.
- I come here, and the first thing, with a master's degree, the first thing I have to do is to make this person's coffee.
- I got called in, he shut the door, and basically said, "Yeah, so and so got a copy of your resume 'cause you applied for this job, and he asked me about you, and I said, 'You don't want her.'"
- I had a sponsor who was creepy and hitting on me complain to my boss when I didn't call him back right away. The guy would show up at meetings while I was on travel, asking me to go outside, putting his hands on me, rubbing my back, grabbing my arm, just happy hands, to the point where there were the guys that would travel with me would sit on either side of me so that this guy couldn't come sit next to me. It just got to the point that I couldn't stand it, I couldn't take it anymore. I told my boss what was going on, and nothing was

done. There was nothing done. I had to keep going to these meetings, then the sponsor started talking about my bad attitude. I had this look on my face, I'm not open, I'm not receptive, I'm contrary, I have a bad attitude, and it needs to get fixed.

- Being told anything you've done before coming here basically doesn't count.
- The whole push for Women in STEM is another barrier. There's such a push, now, there's such an emphasis that when I got my job, when I got promoted, it was because I was the only woman that interviewed, and they had to pick me because, now, women get everything. And so basically, the more emphasis that gets put on hiring women and putting women in positions of authority, the more it does to undermine any type of technical credibility I have because I'm lumped in with people that just got their job because they're a woman, it doesn't matter what I've done, how good of a job I'm doing, it's just I'm a woman.
- I try to downplay the fact that I'm female. I want to be relatable. I don't want people to automatically look at me and say, "Oh, I need to open the door for her."
- I don't want them (men) to think of me as a female.
- I did have to leave, and I left because of that manager. I can tell you right now, it was because of that particular manager. He was very condescending, he was demeaning, and he was just not good for this organization. When he did, I was very glad that he retired for other up-and-coming engineers or women in that area.

- The barrier has been as much as I want to do. If there's something that I want to do, then I go, and I pursue it.
- There are a lot of invisible barriers that battered my ego quite a bit, and it required a lot of inner strength to tackle every day. So those years were incredibly challenging, they were fulfilling, but they definitely left a mark.
- My first day as a branch head, one of the senior guys announced his retirement.
- When I became a division head, all my branch heads asked to be reassigned or retire except one.
- You're trying to assert yourself, trying to be in control, then they're just there to have fun, maybe throw a couple of rocks your way. Some people had the assumption that as a woman and a minority, it was an easy pick to be the branch head because I checked two boxes.
- I was breaking a couple of barriers, and inevitably that kind of stirred up a little bit of challenges, and people just assumed it was my lack of leadership that was causing the problems, which I don't think that was the case.
- I never even talked about my kids at work because I knew that the minute I did that, people would start saying, "Oh, she's got open house to attend," so none of those conversations happened at work; I didn't even put my kid's pictures up, and I was always there.
- It's exhausting having to represent all the time and exhibit your best behavior in the face of other people's difficult behavior.

- I have not experienced any external barriers while with NSWC Corona. I feel it provides equal opportunity for everyone regardless of race, sex, or gender, and I appreciate it. This is more of a personal barrier for me with English being my second language, so I have to work extra hard to communicate my true intentions, and sometimes I don't know if I'd say things the correct way.

Interview Question 9

In the context of leadership aspirations, what are some of the barriers you've faced in joining the management or technical high-grade pool and in developing the required skills and attributes?

As the interview questions shifted to study participants' career progression and their professional experiences in meeting their aspirations, responses to Question 9 had to be separated deliberately from responses to Question 8 (Dixit, 2016). Similar to Question 8, the study participants were honest and open with the researcher about some of the barriers they experienced in joining the management or technical high-grade pool and developing the skills and attributes needed for their positions. Although some are listed here, the researcher is purposely not tying the responses to any specific participant to protect their privacy:

- In a previous organization, when your peers don't consider you a peer. I walk into a room, and I'm like, "Oh, you're my peer." But I walk in a room, and they're like, "Oh, you're not our peer. You're here because we're told you have to be here."

- I think that I identify my barriers and I navigate around them, or I work to remove them in ways and ask for help. If you ask for nothing, you get nothing. And so if no one knows, I'm just going to suffer in silence,
- You have to advocate for yourself. It's about saying to your senior leader, because everyone reports to someone, this is what I need, and this is how you can help me get there. And in turn, this is how what I'm asking you for, or the skill I'm getting ready to develop, will be advantageous to the organization or other people's career growth.
- I haven't had any barriers. I have been encouraged my entire career.
- I've had people in my camp, people that have helped make sure that if there were barriers, they were broken down and helped me get around those barriers, even if I didn't ask for it.
- Time, I wish there were more hours in a day.
- I have my personal life, so sometimes that gets in the way.
- The ability to dedicate some more time to building my technical proficiency.
- It was a bit of a challenge when I became a technical high-grade since I had to create my own path.
- Not being in the military and just trying to pick up on all the military terms.
- Initially, gaining respect from senior high-grades who didn't think I was capable enough, and in addition to that, I think it was also that I was female, and that I was relatively a lot younger than them.
- I was never a supervisor.

- It would have been nice if there was a little bit more guidance or maybe a one-on-one mentor saying, “Okay, this is how to be successful in this position.” Even though I'm a senior member in the organization, it doesn't mean that I couldn't benefit from some mentoring from more senior folks.

Interview Question 10

What are some institutional, environmental, or other enablers that have helped you in your career progression?

The intent of this question was for participants to reflect back on organizational enablers they had experienced while being part of Corona Division. Similar to the emerging theme from Question 1, 75% of participants mentioned some type of mentoring or support as an organizational enabler and extrinsic source of motivation in their career progression. The response by SP8 demonstrates the impact a mentor or supervisor can have on an individual’s self-efficacy and intrinsic source of motivation:

> I'm glad that I took his advice. I think if he would never have approached me, I wouldn't even have thought of trying for the Branch Head job. That's why sometimes you don't see your own potential, but others see it in you, so they will work with you, help you, and encourage you. Sometimes you say, “Oh, there's many other people that are better than me” and so you’re okay in staying where you are at.

In addition, 50% of study participants credited their career progression to direct engagement by a mentor early in their careers as an extrinsic motivator, with several highlighting the importance of men being mentors to women to provide an opportunity to gain a different perspective from someone of the opposite sex. The response provided by

SP2 is a good representation of the study participants' responses regarding making the most of opportunities as they present themselves:

> Opportunities, I like to call challenges opportunities. I take advantage of every opportunity given to me to learn and absorb it like a sponge, I absorb, and I observe. I observe leaders, which has been very powerful in my career and influenced me and how I have progressed as a leader and understand how to respond in a sensitive or conflicting situation, not just by taking notes in the meeting but truly observing the people the situation.

Interview Question 11

In your opinion, why are there so few women in high-grade positions or in the senior management/leadership ranks at this organization?

This question focused directly on gaining the study participant's perspective of the level of women's representation in the STEM high-grade cadre. There was a lot of discussion on demographics and women in STEM fields across the country being reflective of what is coming out of American institutions and the educational systems and the demographics within the Navy and the environment today being reflective of what the Navy looked like 40, 30, and 20 years ago which was primarily White males based on the study participants' responses. The response provided by SP2 is a good summary of the discussions shared by study participants on both of these themes:

> When you look at the military and look at the Navy's demographic in general, way back when 30, 40 years ago, women weren't in positions in the military 50 years ago, that were operational-minded necessarily. I'm not saying they didn't exist; I'm saying predominantly they weren't. They were in the medical field;

> they may have been in administration. Still, they certainly weren't doing what we see today and having those opportunities, for whatever reason. Over the years, women have had this traditional role of raising families, so they would do nontedious work, nonstressful work, nondangerous work, and because the expectation was that they're raising this family and family is important to me. But my work is also important to me, so I struggled with how I have that work–life balance because I have this passionate love for work, and I want to be at work for 12 hours a day. It almost can be unhealthy sometimes, but at the same time, I get great satisfaction and raising my children, but work–life balance was one of those things where it was my own barrier. I created my own barrier.

The perspective shared by SP3 described an organizational barrier starting at the first leadership opportunity available for men and women, often the branch head or technical lead positions. In the example shared, she highlighted the impact that delays or pauses in career progression can have over time on women as they get further in their careers. In the federal government, this is often referred to as time in grade, which is needed to be promoted. SP3 stated,

> The root of it is, going back to what makes us comfortable. If we start at a lower-level position, have a White male, and have a female or a female of color, and in the interviews, they're both toe-to-toe equally qualified. So it just comes down to who we are going to choose. Either one would be great. For some reason, I feel like historically, they'll go with a White male first and say, "Okay, we'll get her next time." Okay, so let's say the next time is 2 years from now, 3 years from now, and the next time they do hire her. Still, now it's 5 years later and a high-

> grade position comes up, so now you have the same two people. They interview again, and again, they're toe-to-toe, they'd both be great at it, but now we're still going to go with the White male because he has more experience, and the reason he has more experience is because you chose him first in the beginning. So I feel like once we start getting to these higher-level positions, you have to go back to those first leadership-type positions. We have to start choosing women then and letting her go first, instead of letting him go first, because then when we start getting to these higher-level positions, it always comes down to well, he has more experience. Well, why does he have more experience? Because way back then, we gave him the opportunity first, and I really think that's the root of it, and I think that's the mitigation, we have these team leads, and we have these first-line supervisors. That's where we need to start choosing her first, so then she's going to get those opportunities and grow as a leader. So then, when the other positions open up, she will have that experience level that will give her that extra edge or push or at least make her competitive.

In reviewing responses from all study participants, over 50% were trailblazers in their technical areas and the first women to hold supervisory or technical high-grade positions within their specialized areas at Corona Division. They were the first to go to college, the first woman supervisor, the first minority in leadership, the first technical high-grade, and so forth. They shared that although it was fulfilling, it was also extremely exhausting and mentally and emotionally challenging. Some participants also shared the perspective that women just do not want to deal with being the first to be a

Branch Head, Division Head, or Technical High-Grade in their technical area. SP7 stated,

> I think the path up the ranks can be harsh, and it can require some sacrifices, and so it can be intimidating, and balancing a very challenging workload at work, in addition to having to deal with all of the different personalities that you may encounter and on top of that, raising a family is very, very hard, so it can be a demanding work–life balance.

Organizationally, several participants described the challenges to establishing a high-grade position, which is also seen as a barrier to increasing the number of women in high-grade positions. As SP5 shared in her response, there are only so many high-grade positions within the organization:

> How many high-grade positions do we really have? A lot of these high-grade positions are pretty new, and so as far as line managers, there's just really not that many of them, and then for the technical high-grades, they're all kind of relatively new positions, and there's push back to creating those positions. I've had one teed up and now it's like, well, you don't need that. Yeah, I do need that. Yes, I do need this position, but within the department, there's pushback, you don't need a high-grade for that, you don't need this, we don't need that. Why?

Interview Question 12

What, in your opinion, should be done by the individual (you) and by the organization (Corona Division) to enable more women to aspire to the leadership or technical high-grade ranks successfully?

In the original study by Dixit (2016), this question was an attempt to break the seemingly negative reflection by the participants, who seemed to have slowly drifted from being satisfied with their job and career to a latent feeling of frustration about an institution where there were impediments to their career aspiration. This was the opposite for the participants in this study who generally became more satisfied with their jobs as their responsibilities and organizational impacts increased. In addition to the focus on supporting leaders, mentoring, and the responses and themes captured in Question 11, study participants shared some additional insight. In her response, SP7 highlighted how self-efficacy, the resilience, and toughness of women leaders could also limit them:

> Women senior leaders are tough, they didn't rise to the occasion without being tough, without making sacrifices, and so they may not proactively seek help, they may be dealing with a lot of challenges, but they don't reach out because they've never reached out.

Although the study participants highlighted the importance of being a role model for others, they may not realize the importance of asking for assistance, being vulnerable, and remaining confident in their role. Suppose other women do not see this being demonstrated. In that case, they may feel like they need to have the same or similar level of competence and ability to "figure it out on their own" before considering becoming a high-grade. Currently, there are several employee resource groups in the organization, Women in Technology being one. The response provided by SP5 addresses groups like this and provided a differing opinion on the need to focus on women in STEM,

specifically the larger organizational focus on increasing the number of women in the STEM field:

> The organization needs to back off the women thing, and instead of focusing on women and women in technology, women, this and women that. Back off and let it happen naturally. Let's get more females into the workforce, let's look at making this a place that people that women are gonna wanna work at, and as we get more women in the general workforce, they'll bubble up to management naturally, if you're selecting the right person, but any type of emphasis and thrust on, women, women, women, all you're gonna do is discourage the men from applying.
>
> When you start hearing things from the workforce about a high-grade position opening up but that "I'll never get it 'cause I've got the wrong equipment," it's that kind of thing that makes you think, maybe we're doing something wrong. The intent is good, but in practice, we're not doing it, right. I don't want anybody to think that they're blocked from getting a job because they're not female or because they're not male, for that matter. I think we do pick the right person, I've been on interview panels, and I think we've picked the right person time and again. I can't say that they resulted in picking the wrong person on any of the interview panels that I have been on, but recently it's just stomping this down people's throats. And they're sick of it. You have to treat people with equality, and I think that maybe for us, all this focus on women and doing all the stuff, it's having the opposite effect that we want it to. The men hear this stuff "we need more women in leadership. We need more women. Women, women."

> It kind of causes them to be bitter, like, “What the heck is wrong with me? I'm never gonna get ahead. Now, all they're doing is looking for women,” and then God forbid a woman gets selected. It's not because she was the best candidate. It's because she's a woman, and that's it. You know, they don't see anything beyond that.

Interview Question 13

Anything else you would like to add—as either prescription or as caution to colleagues with similar aspirations?

This question allowed study participants to share any additional insight that may not have come through in the interview questions or that they may have thought of while focusing or thinking about this study or during our conversations. The following replies from the study participants highlight the primary intrinsic and extrinsic motivation factors and themes shared in response to this final question.

SP1 stated,

> I think moving in your career, not only for women but all, it's not about checking the box. The important part is being successful wherever you are. If you do everything you can to make the organization successful in whatever position you're in, the organization will see that. They will help you continue to grow because we get the best and brightest moving up in their career to the organization's benefit.

SP3 stated,

> I would say don’t doubt yourself and just go for it. The worse they can say is No, but don't automatically disqualify yourself because you think somebody else is so

much better. If you meet the requirements and it's something you want to do, then go for it. And I wish more females would go for more of these positions because maybe one of them would get it. We need to get more women in the game.

SP7 stated,

> I feel like 20 years ago, it was a smaller command, a much smaller command, and it was just a safe place to work, and we were hanging our hat on independent assessment and getting by. But I think in the last 10 years, we have almost doubled the number of people that we had 20 years ago. I think maybe we're 2000 plus now, and you're seeing young people coming out of these great schools that are coming to Corona not because it's a safe choice or because their families necessarily live nearby, although that's a good thing. But because they want to work here, and now we have several specialties that we can put forth, so we have a lot of different fields in which we're excelling, and we're attracting people, and it's not just a family place to work now, it's a center to be contended with.

Summary

A total of eight women STEM high-grade professionals were interviewed from a prospective sample pool of nine candidates who were eligible to participate in this study based on their validated high-grade position, identified gender, and working in a STEM career field within Corona Division. This chapter presented the research and data collection process and findings from the study including the participants' responses. The study participant responses were coded using open coding, selective coding, and thematic coding to identify themes that emerged from the data. Sample responses were included as part of the analyses to provide support for the themes created.

After analyzing the interview results, the next steps were to gather the information collected and code them to reveal themes that answer the research questions for this study. The results of this process are presented in Chapter 5 and include the major findings from the research, any unexpected findings, study conclusions, and implications for action. Recommendations for future research are also shared along with the researcher's reflection on the research process.

CHAPTER 5: FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Overview

This chapter presents the significant research findings and conclusions based on the data presented in Chapter 4. The tie-ins to the research questions, implications for action, recommendations for future research, and the researcher's reflection on the study process are included. This study aimed to understand how women STEM professionals have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts can be attributed to organizational culture. A qualitative phenomenological case study was utilized to understand the study participants' lived experiences and gain insight into the two research questions:

1. In what ways has Corona Division's organizational climate influenced the retention of women in the STEM career fields?
2. What motivates women in the STEM career fields to stay in their profession?

Qualitative, open-ended interviews were conducted with eight women high-grade STEM professionals to gain insight into their lived experiences and assist the researcher in identifying intrinsic and extrinsic sources of motivation within SDT and the impact of SET on the participants' lived experiences. SET and the intrinsic motivation factors under SDT are specific to the individual (self). Extrinsic SDT motivation factors, including social and environmental factors, are particular to the organization (environment). As high-grade STEM professionals within the organization, these women are recognized as highly technical supervisory and nonsupervisory leaders in their specific disciplines. Study participants had an average of 4 years in their current high-grade role, and 20.5 years at Corona Division. The least amount of time any of the study

participants had been in their current role was less than 1 year and the greatest amount of time was 8 years. The same amount of time, less than 1 year, was identified for the least amount of time a study participant had been with Corona Division, the longest amount of time being 37 years. Conducting elite interviews delivered the most relevant and impactful perspective and discovery of the research question responses from these participants.

These interviews were then transcribed digitally, validated, and coded through an iterative, open coding, selective coding, and thematic coding process to capture the common themes from the responses to assist the researcher in answering the research questions. The coding process revealed several consistent words, perspectives, and themes across the 177 pages of transcripts analyzed. No major outliers were identified in the research study findings, and the researcher was confident that the study participants' perceptions were accurately captured and not inappropriately diluted through the coding process. As a result, collecting additional data would not have introduced additional or different themes or perspectives on the research topics.

Significant Research Findings and Conclusions

With many organizations, including Corona Division, beginning to look past the COVID-19 pandemic, leaders should consider how their future work models could help them retain and recruit the next generation of technical high-grades and women. Although numerous themes were identified as a result of the open-ended interviews and coding of information described in Chapter 4, six significant themes or findings emerged when answering the research questions. The three findings are associated with research question one, and the following three are associated with Research Question 2.

Research Question 1

Research Question 1 asked, "In what ways has Corona Division's organizational climate influenced the retention of women in the STEM career fields?" The following findings relate to this question and provide insight into the impact organizational climate, and extrinsic motivation factors have on the retention of women in the STEM career fields. The significant research findings related to Research Question 1 are the impact exclusion biases can have on career growth and inclusivity within an organization, the effectiveness of passive enablers and the impact of formal champions and mentors, and the need to focus on a healthy work–life balance. These findings are discussed in detail in the following individual paragraphs.

Finding 1. Exclusion Biases, Intended or Otherwise, Depress Career Growth and Inclusivity

Exclusion biases occur when specific population members are excluded from participating as part of the larger group or team (Caeyers & Fafchamps, 2016). The lived experiences shared by study participants highlighted some examples of exclusion bias. Of the study participants, 75% had been at Corona Division for 16 years or more. These participants highlighted how much Corona Division's organizational culture had positively changed regarding exclusion biases toward women over the past 2 decades.

This change has positively influenced the organization and the retention of women in the STEM career fields at Corona Division. Study participants noted this personal observation informally as a result of the number of female peers whom they had when they started 10-15 years ago compared to today. Table 2 also supports this observation by highlighting the year over year increase of women within the organization

since 2017. Based on this data, the largest increase of women occurred in 2018 (+57) and 2019 (+50), with the smallest increase occurring in 2017 (+24).

Although this may be due to multiple factors, to include the COVID-19 pandemic, in 2020 and 2021 the increase of women at Corona Division dropped to an average of 35 for both years. Although Corona Division has continued to increase the number of women across the Command, according to the U.S. Department of Labor (2019b), engineering continues to have the smallest number of women represented in the United States. Based on this, there needs to be a continued focus on increasing the number of women who are entering the STEM career fields at Corona Division and are prepared and willing to compete for a promotion or high-grade opportunity.

For an inclusive work environment to flourish, all members need to feel valued, which can be achieved through purposeful awareness (Hassan, 2009; B. Jackson, 2014; Yohn, 2017). When there is a deliberate focus on increasing a specific gender or group of people, the results can be an unintended exclusion bias for employees of other identified groups or genders (Bruckmüller & Braun, 2020). This exclusion bias can occur with not just gender but also education levels, cultural distinctions, and lived experiences. Sustaining and communicating the importance of an emotionally safe work environment that promotes inclusivity where individuals are valued for their achievements and contributions to the organization is essential for retaining all employees, including women in the STEM career fields. Whether influenced by Maslow's (1954) individual safety and love and belonging hierarchy of needs, McClelland's (1961) affiliation motivator, or Alderfer's (1969) relatedness need, individuals have an intrinsic need to be connected and included in an organization's

interagency network (Gormley & Balla, 2013). When specific groups within organizations begin to feel excluded or less relevant than others, it can create an organizational shift that is unintended and detrimental to the organization's culture (Schein, 1999; Dickerson, 2010).

Finding 2. Passive Enablers are Ineffective for Career Growth, but Engaged Champions and Mentors Make a Difference in Preventing Self-Exclusion

Throughout the interview process, study participants routinely mentioned the value and impact of having a supervisor, peer, or friend support and encourage them early in their careers. These were not formalized rigid relationships but instead, individuals who believed throughout the study participants' careers that they had the potential to do more, have a more significant impact, or make a difference in the lives of others. A common theme from the interviews was the impact having a role model or mentor had in keeping study participants from falling victim to the leaking pipeline and leaving their STEM career or civil service early on or in the middle of their career.

Although there are several facilitating factors and passive enablers already established, such as employee resource groups, mentorship programs, enterprise detail opportunities, and so forth, targeted opportunities also need to occur as more formal and purposeful opportunities that align to the organization's strategic initiatives. Multiple studies have shown that individuals in STEM are less extroverted than in other non-STEM career fields (Adolfie, 2009; Jenkins, 2008; Ware, 2019; Whelan, 2017; Wilkins & Williams, 2009). Although not intentional, individual risk aversion behavior leads to self-exclusion. This self-exclusion artificially inhibits the career development and growth of individuals. Several study participants shared that they applied for their

current or previous position or pursued a STEM career because they were persuaded or encouraged by someone else.

In addition, although study participants were aware of and took advantage of developmental opportunities, mentoring, and coaching programs available for junior and newer employees, they identified a gap in the organization's providing mentors and coaches for senior professionals and high-grades. As high-grades, who were expected to know already what to do, there was a common theme that now more than ever, they need to have a senior manager or technical high-grade to continue to provide that mentorship and guidance to them in their role. This limited access to mentors, coaches, and champions at the senior levels of the organization can be a challenge because these individuals are the senior-level advisors they seek. The research has shown that people tend to mentor individuals who remind them of younger versions of themselves (Adolfie, 2009; Ware, 2019). Because the majority of senior positions are held by men, this becomes a problem for women. Therefore, the organization needs to purposefully set up formal programs to facilitate this mentorship and individual development.

Finding 3. There is a Need to Focus on a Healthy Work–Life Balance

As confirmed in the responses to Question 4 and others, technical competence is an intrinsic motivator (Ryan & Deci, 2000a, 2000b, 2017) for women STEM high-grade professionals. This motivator is likely not just limited to this group of women but to all employees working in both STEM and non-STEM career fields. There is a drive within this group of women to be technically competent, respected for their insight and experience, and be up to date with emerging technology that was described by participants as moving at a rate that keeps it continually out of reach to catch up to.

Study participants shared that the need for technical competence was overwhelmingly in demand and often competed with their ability to meet the demands of their position, their professional growth, and their personal life, which each impact an individual's capability. Several study participants shared how this imbalance between their ability to manage work priorities, remain current with emerging technology and threats, and sustain their personal lives often resulted in the latter being sacrificed.

Like millennials who seek equity, transparency, flexibility, and purpose, individuals want to be in an organization that simultaneously challenges and supports them. Workplace flexibilities and hybrid work environments were common themes in this finding as women high-grades shared their perspectives of reintegrating to a primarily onsite rather than hybrid or virtual working environment that they had experienced the previous couple of years because of the COVID-19 pandemic.

Over 50% of study participants shared that they were either in the process of planning their retirement or actively searching for positions that would allow them to have a better work–life balance where they would be able to attend events, functions, and family experiences that they previously missed prior to the pandemic. Although Corona Division has several flexible schedules and telework options available for its workforce in most of its technical and business areas, they may not be enough to retain this group of women high-grade professionals. It may also impact the pipeline of employees, regardless of gender affiliation, who would be competing to take their place.

Research Question 2

Research Question 2 asked, "What motivates women in the STEM career fields to stay in their profession?" The following conclusions relate to this question and provide

insight into the intrinsic and extrinsic sources of motivation that encourage women in the STEM career fields to remain in their profession. The significant research findings related to Research Question 2 include the level of enjoyment while working in a STEM career field, the way feeling valued and respected also provides purpose, and the way having a manageable work–life balance impacts retention. These findings are discussed in detail in the subsequent individual paragraphs.

Finding 4. Study Participants Enjoy Working in Their Chosen STEM Career Field

As stated in the common themes identified in Chapter 4 for Question 7, which directly asked this research question, the overwhelming response was that these women high-grade professionals enjoy working in their chosen STEM career fields. If they did not enjoy working in their STEM career field, they would do something else that gave them purpose. These women pursued a STEM career field and academic degree, which is the path less followed by women. Although some shared it was for financial and job security, the obstacles many of these women overcame while studying to earn their degree or pursue their careers in this field could not have been accomplished without a genuine interest in the subject and its application.

For most study participants, the ability to work on a complex project, do work that they found meaningful or challenging, and make a difference within the organization were strong intrinsic and extrinsic motivators. This supported the perspective that extrinsic motivation, as part of SDT (Ryan & Deci, 2017), is driven by either external or internal factors depending on the individual and her intrinsic motivation factors as part of SET (Bandura, 1977). For these women, their internal motivation and interest in STEM was enhanced by being able to apply it to solve problems while also continuing to learn

and develop within their field of study. As highlighted within the existing literature on motivation and self-efficacy theory, task-specific self-efficacy growth contributes to general self-efficacy beliefs by improving the motivational process, reducing stress perception, improving life satisfaction, and achievement realization (Bandura, 1997). This genuine interest by the study participants is followed by the ability to use what they have learned to assist the Navy in making day-to-day, tactical, and strategic decisions that impact the nation. In addition to SDT and SET, this ability to make a difference and work on meaningful and purposeful tasks aligns with several motivational theories to include the esteem and self-actualization needs described by Maslow (1954), McClelland's (1961) achievement motivator, and the growth need within Alderfer's (1969) ERG theory.

Finding 5. Feeling Valued and Respected Provides Purpose

In addition to working in a career field that brings internal joy and genuine interest, having contributions recognized and appreciated was a high source of motivation identified. Although study participants shared experiences in which their contributions were initially dismissed, undervalued, or deemed irrelevant, each highlighted the sense of accomplishment with each positive interaction with their male and female peers. In these interactions, they described feeling heard and valued and having their contributions considered. It was acknowledged that even if they were not accepted as the final solution, but as several shared, they wanted to have their ideas considered and on the table like everyone else's on the team.

Feeling supported and encouraged by others also makes a difference in motivating women to stay in their career fields (Adolfie, 2009; Chong, 2020; Ware, 2019; Whelan,

2017). If individuals are in an environment where they feel supported and part of the team, they begin to develop interpersonal relationships, which serve as the connective tissue to feel included and invested in the success of the team and its members. Study participants shared that this inclusion among peers and interpersonal relationships were essential in promoting their self-efficacy and pursuit of being seen as a STEM professional regardless of gender. This enhanced level of self-efficacy also helps to contribute to individuals' strong desire to make a difference in the development of others and the organization while also feeling like they have the autonomy to make decisions that impact the organization and its people for the better (Bandura, 1986; McMillan, 2010; Ryan & Deci, 2000b; Schein, 1999).

Finding 6. Having a Manageable Work–Life Balance Impacts Retention

In his research, Gandhi (2009) identified the *mommy track* as a self-exclusion (or delay) regarding career aspirations because of an increased focus on family development and connectedness outside of the workplace. The women who were also mothers shared their decision to prioritize growing and raising a family over career progression for at least a portion of their careers. These women are passionate about their work and the difference they are making, but they do not want to do that at the expense of their close family relationships.

Although the COVID-19 pandemic has had several devastating impacts on many lives, study participants shared that it has also resurrected the work–life balance discussion within their families and the workplace. Before the pandemic, these women worked long hours and drove long commutes to fulfill their professional sense of purpose. During the pandemic when they were able to work from home, these women

rediscovered and nurtured their personal sense of purpose and close relationships. Several participants shared that they are no longer willing to give this up and return to the previous imbalance between their lives and work. Maintaining a healthy work–life balance and the autonomy to make decisions will either be a retention multiplier and motivator for women or a retention threat depending on how organizational leaders manage it.

Implications for Action

The results of this study may be insightful for public sector organizations and leaders to understand how to retain and motivate STEM professionals regardless of gender identification. As organizations continue to prepare the current and future generation of civil servants and leaders to face the complex problems they will need to maneuver through based on existing and emerging challenges, retention and competition for human capital talent and technical STEM leaders will grow in demand. Corona Division will need the tools and resources to meet its organizational and strategic goals and mission while providing the highest level of services to its employees and the nation. To achieve this, the following recommendations are provided for consideration based on the research findings. Although this study focused on women high-grade STEM professionals, these recommendations are not specific to just this group and will benefit the organization holistically. The first three recommendations are based on Findings 1, 2, 4, and 5, which primarily deal with mentorship, employee engagement, and career growth. The fourth recommendation is based on Findings 3 and 6, which both deal with work–life balance.

Recommendation 1: Expand Diversity and Inclusion Awareness Training

I recommend Corona Division expand on its existing diversity and inclusion training to include training on emotional intelligence. As Vu-Fulmer (2022) observed,

> The constructs of trait emotional intelligence have been well studied and demonstrated to integrate the Big Five personality taxonomies (extroversion, conscientiousness, agreeableness, neuroticism, and openness to experience) which provide a method through improving relationships by understanding and knowing the behaviors of others. (p. 25)

For almost 3 years because of the COVID-19 pandemic, Corona Division employees have worked in several work environments: full telework, partial telework, and onsite. During this same period, the Command has hired 25% of its existing workforce, with many team members only interacting with their peers and leadership virtually.

In addition, studies show that the demographics of the traditional workforce has shifted to embrace a more heterogeneous mix of employees, values, and cultures of varying norms with organizational leaders tasked to navigate situations requiring social awareness and self-management (Vu-Fulmer, 2022). To do this successfully, enhanced employee awareness on emotional intelligence and inclusion topics such as the impacts of exclusion bias, the value of inclusion within teams, and the ways diversity of thought can result in improved decision making and outcomes should be added as a strategic goal to improve workforce engagement. Although this recommendation is primarily focused on Finding 1, it impacts the other findings related to employee engagement, mentorship, and employee retention.

Recommendation 2: Establish a Formal High-Grade Mentoring Program

I recommend Corona Division enhance its exiting employee mentoring program and require that employees who are promoted to technical high-grade positions be assigned a formal mentor for their first 90 days in their new position. Several study participants who were technical high-grades expressed the professional challenge and ambiguity of becoming a technical high-grade and needing to develop their position and relevance within the organization and the programs they support. Studies show that the first 60 to 90 days in a new position are a critical time for employees, and employees seek guidance from peers and mentors whom they have a formal or informal connection with based on experience, race, gender, and so forth (Flores, 2021; Goode & Dixon, 2016; Williams, 2017). Ideally, mentors would be identified in advance for specific positions and be part of the hiring process as high-grade positions are recruited. This would provide an opportunity for the mentor to be involved in the initial selection and follow-on development and mentorship of the high-grade selectee.

Formalizing a high-grade mentoring program would not only provide opportunities for future cross-organization partnerships and collaboration but also make becoming a technical high-grade less intimidating for employees who are in the technical high-grade pipeline. As part of this mentoring program, employees in high-grade positions should be required to complete a high-grade dashboard summary. This one-page summary would highlight the major duties and responsibilities in their current high-grade position, previous positions that offered them the experience and exposure to prepare them for their current position, major projects and programs they have supported, and rotational assignments or career details completed. A proposed template for the

organization to use can be found in Appendix G. As a secondary benefit, this dashboard can also be used by non-high-grade employees to identify potential high-grade mentors throughout the Command based on previous positions they have held or programs they have supported.

Recommendation 3: Establish a High-Grade Employee Resource Group

I recommend Corona Division continue to support its existing employee resource groups but set specific strategic goals and high-grade engagement targets while also establishing a high-grade employee resource group. Among other benefits, employee resource groups provide an opportunity for an organization's workforce to be heard, valued, and engaged while also being great partners for identifying gaps in an organization's talent development process (Goode & Dixon, 2016). Currently the Command has two employee resource groups: women in technology and LGBTQ+ (lesbian, gay, bisexual, transgender, queer, and others). Of the study participants, only two were aware of and referenced the women in technology employee resource group. Several others shared their desire for this specific type of group to be formed to share experiences and knowledge with other women as well as a desire for a high-grade employee resource group.

Several studies have shown the value of employee resource groups for the individual members as well as the organization itself (Hall, 2021; Ward, 2012). Although the Command already has an employee resource group focused on women in technology, it should establish and formalize a high-grade employee resource group to provide a forum and environment for high-grades to gather together and share experiences, provide mentorship, and collaborate on projects and programs. The employee resource groups

should be part of the Command's employee engagement strategic goal and provide periodic updates on initiatives and impacts to Corona Division leadership and executives. In addition, each employee resource group should be chartered to develop and establish a communication strategy and sustainment plan to assist with workforce awareness and involvement.

Recommendation 4: Identify Implementable Work–Life Balance Initiatives

I recommend Corona Division conduct an exploration to identify strategies for enhancing work–life balance for employees. Several study participants described the challenges of being a working STEM professional and a caregiver to their children, spouses, or parents in various forms. Bianchi (2011) found that between 1975 and 2009, the labor force rate of mothers with children under age 18 increased from 47.4% to 71.6%; mothers return to work much sooner after the birth of a child than they did half a century ago, and more children are being raised by a single parent, usually their mother. Hahm (2021) also found that mothers with a higher preference for indirect parenting experienced higher levels of enrichment, and mothers whose jobs had lower levels of compensating differentials (e.g., inflexible schedules) experienced higher levels of time-based conflict (in the work-family interface). When evaluating organizational work–life balance initiatives and how they may impact employee retention, commitments outside of the workplace need to be assessed as the workforce continues to span generations and various family demographics.

In a recent study conducted by Hupfer et al. (2021), large global technology firms on average will reach nearly 33% overall female representation in their workforces in 2022, up slightly more than two percentage points from 2019, and that that percentage is

predicted to continue to grow. This growth is significant to this study because the retention and representation of women in the STEM career fields will continue to be in demand. Results from a 2019 study (van Veelen et al.) using a structural equation model with a population size of over 800 participants (177 women and 630 men) also demonstrated that women in STEM face double trouble. Based on the study findings, the combination of working almost solely with male colleagues (being outnumbered) and working in the technical sector (where women are negatively stereotyped) predicted the highest levels of experienced gender identity threat, which in turn negatively predicted women's work engagement and career confidence (van Veelen et al., 2019).

By implementing these four recommendations based on the research findings from this study, Corona Division and other similar organizations will have an increased competitive advantage in retaining and developing their current and future STEM talent at all levels of the organization while continuing to positively impact the U.S. Navy and the nation while enhancing the readiness of its workforce.

Recommendations for Further Research

Recommendations for further study are provided as a guide for future research efforts. The present study was intended to determine how senior-level women high-grade STEM leaders have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts can be attributed to organizational culture. The findings and conclusions from this study can be made more robust by including the following perspectives:

- Corona Division senior-level men high-grade STEM leaders,

- expanding the population to the next lower level of women STEM professionals within Corona Division at the ND-04 and ND-05 non-high-grade levels,
- conducting additional research on non-STEM senior-level-women high-grade leaders at Corona Division within the business and technical departments,
- conducting research that incorporates all high-grade employees across the Command regardless of career field, or
- repeating this research at a different NAVSEA Warfare Center to compare the lived experiences and themes that emerge from women high-grade STEM professionals with a potentially different organizational culture.

These additional perspectives can provide a more robust and comprehensive analysis of the larger workforce that makes up Corona Division and the NAVSEA Warfare Centers. Although this study focused on a specific population of the workforce, women high-grade STEM leaders, additional insight and differing perspectives would likely be found based on the lived experiences of other members of the workforce as well as other variables to include geographic location, education level, gender, and professional experience (Creswell, 2015). These additional perspectives may support or contradict the findings of this study based on a differing sample size and organizational population.

Concluding Remarks and Reflection

This study incorporated a qualitative research design using self-determination theory and self-efficacy theory as a theoretical foundation for the study. Through these lenses, the researcher sought to understand how senior-level women high-grade STEM

leaders have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts can be attributed to organizational culture. Eight women high-grade STEM professionals were interviewed using open-ended questions and shared their lived experiences. The common themes formulated from these interviews were described in Chapter 4. The research questions were answered in this chapter and identified six significant findings that emerged from the research. From these findings, four recommendations were provided for consideration by Corona Division. The researcher's evolution of interest was discussed in Chapter 1 and further explored in Chapter 3 as part of the researcher interest.

As highlighted in the literature review, over 3 decades ago, a similar study was conducted by Corona Division and included interviews with 10 non-high-grade women engineers. Although the findings in that study are different than this study, there were some similar common themes such as women not wanting to take a higher-level role or be the first in the position because of the pressure of being in the spotlight and the perceived expectation to fail versus succeed and challenges of having a healthy work–life balance between family and job requirements resulting in careers being placed on hold. It was surprising to the researcher that these two common themes still resonated with study participants. It also served as a reminder that sometimes leaders need to look to the past to predict the future needs of professionals. The recommendations presented in this chapter seek to address these remaining common themes.

The insight gained through this study further contributes to the field of public administration by assisting in addressing the leaking pipeline and retention of STEM professionals within public and private organizations. Study participants substantiated

some of the common factors, such as gender stereotypes, organizational cultures, and workplace climates, that were identified in Chapter 1 as impacting women who pursue and work in STEM fields. These factors and others shared by study participants can be mitigated through open dialogue on the value of diversity and inclusion, formalizing support structures for STEM professionals such as mentoring and engagement opportunities, and exploring strategies to achieve the right work–life balance mix for the organization and its employees based on mission demands. The recommendations provided from this study are easily transferrable to other NAVSEA Warfare Center Divisions as well as other nonmilitary public organizations such as local and county government offices with a highly technical workforce. These recommendations can also be implemented in school districts and higher education institutions that are struggling to retain their teachers and academic professionals because of limited funding, reduced enrollment, or increased attrition (Flores, 2021).

The findings from this study also align with the thoughts and experiences shared by Heidi Shyu who serves as the Under Secretary of Defense for Research and Engineering. As she shared during the April 2022 Women in STEM conference at the University of California, Los Angeles, women in STEM need to have self-confidence, believe in themselves, demonstrate their value, and speak up and communicate so that their voice is heard (Lopez, 2022).

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APPENDICES

APPENDIX A

Interview Protocol and Script

STUDY TITLE: **Women in STEM: A Case Study of Naval Surface Warfare Center Corona Division**
TIME OF INTERVIEW: _____ DATE: _____
GENDER: _____ HIGHEST EDUCATION LEVEL OBTAINED: _____
YEARS/MONTHS AT CORONA DIVISION: _____
CURRENT POSITION: _____
HOW LONG IN CURRENT ROLE: _____ SUPERVISOR POSITION (Y/N): ___
The following provides an outline to guide the interview process for each participant to maintain consistency.
Introduction:
Welcome and overview of session:
Hello and thank you for your participation in my research study on women "high grade" STEM leaders within NSWC Corona Division. My name is Tomas Gabriel Beauchamp Hernandez, and I am a doctoral candidate at California Baptist University. I am working on a Doctor of Public Administration terminal degree. You have read, acknowledged, and signed the Inform Consent letter that explains the intent and characteristics of the study, as well as the authorization form to audiotape this interview. I will ask you 13 questions regarding your background and career experience at Corona Division from the perspective of a woman science and engineering "high grade" professional. Today's discussion will be conducted within a 60 minute timeframe. When we get close to the end time of the appointment, I will let you know. We will not go beyond that time unless you agree to do so.
Background:
The issue of increasing the number of women pursuing STEM degrees and working in the STEM field is not a new one; however, even with the continued focus to stop the leaking pipeline, retention of women in STEM continues to be a struggle for public and private organizations. Understanding the strategies, skills, and behaviors developed and demonstrated by successful women engineering leaders within a military science and engineering organization can be insightful for the organization and its leaders. In an environment where civil servants are being "asked to do more with less, then asked to do even more with even less, and ultimately asked to do everything with nothing" (Lavigna, 2013, p. 37), there will be an ongoing demand for women in government, and organizational culture may be the game-changer in being able to succeed regardless of political environments. It is important to understand how senior level women "high grade" engineers have been successful in a federal laboratory environment, why they have continued their science and engineering careers, and what impacts, if any, can be

attributed to organizational culture as we strive to retain and prepare the next generation of "high grade" leaders across the Command.

Purpose:

The purpose of this study is to explore the leadership and development experiences of "high grade" women in the science, technology, engineering, and mathematics (STEM) and STEM and management (STEM+M) career fields have had within Corona Division. "High grade" women in this study will be defined as Corona Division government employees who are over the age of 18, are in the ND or NT pay band, and are in Command approved "high grade" positions.

Ground Rules:

Please be aware, your participation in this study is strictly voluntary, and you may withdraw from the study at any time without fear of penalty or loss of benefit to you. All responses will be kept confidential. Feel free to disclose as much about your experiences as you feel comfortable. Any reference to your responses contributing to the study will be coded and any identifiable information will be removed. If there are any questions that you cannot answer or do not feel comfortable answering, we can skip over those questions. In addition, I may be taking notes during our conversation and audio recording our interview for a transcript. There are no foreseeable risks to you from participating in this study. There are no incorrect responses; say whatever comes to mind. I will retain all notes and audio tapes and no names will appear on the final report. Again, our discussion will focus on your background and career experience at Corona Division from the perspective of a woman STEM "high grade" professional. Do you have any questions before we get started?

II. Interview Questions

A. Section One – *personal background, career progression, and motivation questions*

1. Why did you choose to enter the science, technology, engineering, or mathematics (STEM) career field?
2. How has your career progressed so far?
3. What are your measures for a successful career?
4. What are your impressions of the qualifications and characteristics of a senior manager & leader in this organization?
5. Why did you want to be a 'technical' manager (and/or a leader) in this organization?
6. Describe what, in your opinion, are the aptitudes and credentials required to be a successful manager/ leader in this organization.
7. As a woman, what motivates you to remain in the STEM profession?

B. Section Two – *career barriers and enablers*

8. Describe some of the barriers that you've faced in your career so far.
9. In the context of leadership aspirations, what are some of the barriers you've faced in joining the management or technical high-grade pool and in developing the required skills and attributes?

10. What are some institutional, environmental, or other enablers that have helped you in your career progression?
11. In your opinion, why are there so few women in high-grade positions or in the senior management/leadership ranks at this organization?
12. What, in your opinion, should be done by the individual (you) and by the organization (Corona Division) to enable more women to aspire to the leadership or technical high grade ranks successfully?
13. Anything else you would like to add – as either prescription or as caution to colleagues with similar aspirations?

III. Debriefing

Thank you for your participation. The information and responses you shared with me today will remain confidential. I will not use your name or any other identifying information in the dissertation. Have a wonderful day.

APPENDIX B

Approval to Modify Existing Instrument Questions

From: Rahul Dixit
Sent: Tuesday, November 30, 2021 6:16:45 PM
To: Tomas Beauchamp-Hernandez **Cc:** Jeannette Guignard
Subject: Re: Request for approval to instrument for doctoral dissertation

Dear Tomas

Permission granted.
Please use/ edit the survey instrument as needed for your research purpose.
Good luck in your research and thesis development.
rahul

On Tue, Nov 30, 2021 Tomas Beauchamp-Hernandez wrote:

Dr. Rahul Dixit,

Greetings. I am a doctoral candidate at California Baptist University located in Riverside, California. I am pursuing my Doctor of Public Administration degree and am reaching out to you for approval to use the research instrument used in your 2016 doctoral research titled *Barriers to Career Advancement: Asian Americans in the U.S. aerospace industry*.

My qualitative study seeks to understand how women STEM professionals have been successful in a federal laboratory environment, why they have continued their STEM careers, and what impacts, if any, can be attributed to organizational culture. I will be conducting my study using elite interviews of senior women leaders and technical subject matter experts in the STEM fields within Naval Surface Warfare Center Corona Division located in Norco, California. Since I will be limiting my study to this small group of individuals, I anticipate a maximum of twelve participants for my research.

There are two research questions in my study:
(R1) In what ways has Corona Division's organizational climate influenced the retention of women engineers?
(R2) What motivates women in STEM to stay in their profession?

Your instrument best aligns to my research questions, and I would be making minor pen and ink changes to your original instrument used. The specific changes and proposed

instrument I would like to use is in the attached document for your review and concurrence.

I appreciate you not only sharing your research but allowing me to use your instrument to further my research as well. I am including my dissertation chair Dr. S. Jeannette Guignard on cc should you have any questions for her as my faculty advisor.

Kind regards,
Tomas G. Beauchamp Hernandez, MBA

APPENDIX C

Interview Questions

A. Section One – *personal background, career progression, and motivation questions*

1. Why did you choose to enter the science, technology, engineering, or mathematics (STEM) career field?
2. How has your career progressed so far?
3. What are your measures for a successful career?
4. What are your impressions of the qualifications and characteristics of a senior manager & leader in this organization?
5. Why did you want to be a 'technical' manager (and/or a leader) in this organization?
6. Describe what, in your opinion, are the aptitudes and credentials required to be a successful manager/ leader in this organization.
7. As a woman, what motivates you to remain in the STEM profession?

B. Section Two – *career barriers and enablers*

8. Describe some of the barriers that you've faced in your career so far.
9. In the context of leadership aspirations, what are some of the barriers you've faced in joining the management or technical high-grade pool and in developing the required skills and attributes?
10. What are some institutional, environmental, or other enablers that have helped you in your career progression?
11. In your opinion, why are there so few women in high-grade positions or in the senior management/leadership ranks at this organization?
12. What, in your opinion, should be done by the individual (you) and by the organization (Corona Division) to enable more women to aspire to the leadership or technical high-grade ranks successfully?
13. Anything else you would like to add – as either prescription or as caution to colleagues with similar aspirations?

APPENDIX D

Participant Informed Consent

Study Title: Women Leaders in STEM: A Case Study of Naval Surface Warfare Center Corona Division

Researcher: Tomas Gabriel Beauchamp Hernandez

Dear Prospective Participant,

You are invited to participate in a research study conducted by Tomas Gabriel Beauchamp Hernandez who is a doctoral candidate within California Baptist University's Doctor of Public Administration program. This research seeks to describe the experiences of women identified as high-grade STEM professionals at Naval Surface Warfare Center Corona Division (Corona Division). The researcher will be using a qualitative phenomenological case study design that will allow him to explore the lived experiences that have resulted in these women STEM professionals achieving the high-grade level within the organization.

For the purpose of this study, high-grade women STEM professionals are defined as Corona Division government employees who are over the age of 18, are in the ND or NT pay band, and are in Command approved high-grade positions. You have been identified as being one of twelve women in a "high grade" science, technology, engineering, and math (STEM) or STEM+M (management) position that is eligible to voluntarily participate in this study. There are no reasonably foreseeable risks or discomforts that you should experience, and you may stop your participation at any time without penalty or negative consequence. This research study is being conducted from an academic perspective and is not part of any official Department of the Navy research; however, Command approval has been received to perform this research at Corona Division. Participation in this study is voluntary and compensation for participation will not be provided by Corona Division or the researcher for this study. While not anticipated, any new findings that may impact participants' willingness to continue will be reported to participants.

All information gathered will be kept confidential and your specific participant information will not be disclosed by the researcher. All participant identifiers (names, position in the organization, etc.) will be removed from the identifiable private information and, after such removal, the information can potentially be used for future research studies or distributed to another investigator for future research studies without additional informed consent from the participant. This research can be insightful in understanding how organizations can create an environment and culture that fosters diversity of thought and experiences that enhance the retention of women STEM professionals and if an organization's culture impacts the retention of these women.

What does your participation entail:

• Your participation will involve an online interview in which you will give your honest response to 13 interview questions regarding your background and career experience at Corona Division from the perspective of a woman STEM "high grade" professional.
• Your participation will take 60 minutes or less.
• Your participation is strictly voluntary.
    It is your choice to participate in this research or choose not to.
    If you choose to participate, you may change your mind and leave the study at any time.
    You may skip any questions you do not want to answer.
    Refusal to participate or leaving during the interview process will not cause any negative consequences.
• Strict procedures are in place to protect your privacy and confidentiality
• Your responses to the questions will never be linked or identified to you
    In the research document, responses will refer to an alphanumeric coding system.
• All interviews will be audio recorded for accuracy purposes only.
    Your recorded interview will be downloaded and saved using a password protected file. The file name will refer only to the assigned alphanumeric code and the date of the interview.
    The researcher is the only one who will have access to the cross reference between the alphanumeric codes and participant names. This information will never be made public.
    The researcher will destroy all electronic and paper documents five years after publishing the study by shredding paper documents and deleting electronic files.
• You will not be paid for participating in this research study.

We cannot promise any benefits to you for taking part in this research. However, we believe this research will contribute in informing leaders within science and engineering organizations on the impacts organizational culture has on not only the retention of women in STEM but also human capital and the environment they operate in while striving to achieve its mission (Heath & Palenchar, 2009).

There are no reasonably foreseeable risks, discomforts, or inconveniences as a result of participating in this research study. Although I do not anticipate any risks, if you experience discomfort, you may contact me (the researcher), or the CBU Counseling Center (951-689-1120, https://www.calbaptist.edu/counseling-center/).

The researcher for this study is Tomas Gabriel Beauchamp Hernandez and his faculty advisor and dissertation chair is Dr. Jeannette Guignard. Should you have any questions about this research or study, you can contact the researcher at [redacted] or his doctoral research advisor, Dr. Jeannette Guignard, at [redacted]. This research has been approved and reviewed by the Institutional Review Board (IRB). The IRB is a committee tasked with the review of research and the protection of human participants. If you should have

any questions about the nature of the research, about your participation, or your rights as a research participant, please contact the IRB via email at IRB@calbaptist.edu.

What are the next steps once you choose to participate in this study:

The researcher will need this signed Statement of Consent which confirms that the researcher has explained the purpose of this research and the intended outcome.

• The Participant understands that upon receiving the signed Statement of Consent, the researcher will contact me by email to establish a mutually agreeable date and time to participate in an in-person virtual interview.
• The Participant understands that the researcher will ask questions about experiences as a woman STEM "high grade" professional at Corona Division.
• The Participant acknowledges that ALL INTERVIEWS WILL BE AUDIO RECORDED and that all audio recordings will be used for research purposes and will not be used outside the research project.
• The Participants participation in this study should take about 60 minutes or less.
• The Participant understands that their responses will be confidential and that anonymity will be preserved by using an alphanumeric code in all writings that pertain to the research findings.
• The Participant acknowledges that their name will not be associated with any results of this study.
• The Participant may contact the researchers or irb@calbaptist.edu for additional questions.

By digitally signing this form, you acknowledge that you have read the informed consent, you understand the nature of the study, your interview will be audio taped and the potential risks to you as a participant, and the means by which your identity will be kept confidential. Your signature on this form also indicates that you are 18 years old or older and that you give your permission voluntarily to serve as a participant in the study described.

X_____
Please sign here if you consent to participate in the study

Please email this form back to me if you agree to participate. I will then contact you by email to set up a mutually agreeable date and time to conduct the interview.

Thank you for your consideration and participation in this study,

Tomas G. Beauchamp Hernandez

APPENDIX E

Organizational Research Agreement

DEPARTMENT OF THE NAVY
NAVAL SURFACE WARFARE CENTER
CORONA DIVISION
PO BOX 5000
CORONA, CA 92878-5000

IN REPLY REFER TO
5000
Ser 00/3781
01 DEC 2021

From: Technical Director, Naval Surface Warfare Center, Corona Division
To: Institutional Review Board, California Baptist University

Subj: CONSENT TO RECRUIT FROM NAVAL SURFACE WARFARE CENTER, CORONA DIVISION

1. I agree to allow Mr. Tomas Gabriel Beauchamp-Hernandez to recruit participants from Naval Surface Warfare Center, Corona Division for the study entitled "Women Leaders in Science & Engineering: A Case Study of Naval Surface Warfare Center, Corona Division". I understand the benefits, risks, and time involved in participation in this study. I understand that individual participation is contingent upon voluntary and informed consent. I am fully aware of the procedure and agree to allow interviews to be conducted in the manner approved by California Baptist University's Institutional Review Board (as described in the protocol).

2. My point of contact for this matter is my Executive Assistant, Ms. Sonia Fields at 951-393-5135 or via e-mail: Sonia.h.fields.civ@us.navy.mil.

D. M. COSTLOW, SES
Technical Director

APPENDIX F

Bill Of Rights for Research Participants

California law, under Health & Safety Code '24172, requires that any person asked to take part as a subject in research involving a medical experiment, or any person asked to consent to such participation on behalf of another, is entitled to receive the following list of rights written in a language in which the person is fluent. This list includes the right to:

1. Be informed of the nature and purpose of the experiment.

2. Be given an explanation of the procedures to be followed in the medical experiment, and any drug or device to be utilized.

3. Be given a description of any attendant discomforts and risks reasonably to be expected from the experiment.

4. Be given an explanation of any benefits to the subject reasonably to be expected from the experiment, if applicable.

5. Be given a disclosure of any appropriate alternative procedures, drugs or devices that might be advantageous to the subject, and their relative risks and benefits.

6. Be informed of the avenues of medical treatment, if any, available to the subject after the experiment if complications should arise.

7. Be given an opportunity to ask any questions concerning the experiment or the procedures involved.

8. Be instructed that consent to participate in the medical experiment may be withdrawn at any time and the subject may discontinue participation in the medical experiment without prejudice.

9. Be given a copy of the signed and dated written consent form.

10. Be given the opportunity to decide to consent or not to consent to a medical experiment without the intervention of any element of force, fraud, deceit, duress, coercion, or undue influence on the subject’s decision.

APPENDIX G

High-Grade Dashboard Template

High-Grade Dashboard

Title of Incumbent, Grade/Series

Department

First, Last Name

Insert Picture Here

Date: DD/MM/YY

Major Duties and Responsibility	Necessary Experience & Competencies	Other Helpful Credentials
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•
•	•	•

POSITIONS THAT OFFERED THE EXPERIENCE AND EXPOSURE TO PREPARE INCUMBENTS TO TAKE ON THESE DUTIES AND RESPONSIBILITIES

Gateway Positions

Title/Code	Series/ Grade
Organization	Start Date (DD/MM/YY)
Supervisor	End Date (DD/MM/YY)
Title/Code	Series/ Grade
Organization	Start Date (DD/MM/YY)
Supervisor	End Date (DD/MM/YY)
Title/Code	Series/ Grade
Organization	Start Date (DD/MM/YY)
Supervisor	End Date (DD/MM/YY)
Title/Code	Series/ Grade
Organization	Start Date (DD/MM/YY)
Supervisor	End Date (DD/MM/YY)

Title/Code	Series/ Grade
Organization	Start Date (DD/MM/YY)
Supervisor	End Date (DD/MM/YY)
Title/Code	Series/ Grade
Organization	Start Date (DD/MM/YY)
Supervisor	End Date (DD/MM/YY)
Title/Code	Series/ Grade
Organization	Start Date (DD/MM/YY)
Supervisor	End Date (DD/MM/YY)
Title/Code	Series/ Grade
Organization	Start Date (DD/MM/YY)
Supervisor	End Date (DD/MM/YY)

MAJOR PROJECTS AND PROGRAMS / ROTATIONAL ASSIGNMENTS / CAREER DETAILS

Projects & Programs

Program /Project	Sponsor	Position/Role	Start Date	End Date
Name	Organization	Title	(DD/MM/YY)	(DD/MM/YY)
Name	Organization	Title	(DD/MM/YY)	(DD/MM/YY)
Name	Organization	Title	(DD/MM/YY)	(DD/MM/YY)
Name	Organization	Title	(DD/MM/YY)	(DD/MM/YY)
Name	Organization	Title	(DD/MM/YY)	(DD/MM/YY)
Name	Organization	Title	(DD/MM/YY)	(DD/MM/YY)