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An Exploration of Barriers Female Engineers Face in the Workplace

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ABSTRACT: The global focus to attract more females to the engineering profession and oil and gas companies are of paramount importance. There is a dire need to train and cultivate female engineers to increase economic advancement and innovation. Worldwide, the demand for those equipped with engineering expertise exceeds the talent pool pipeline. Despite laws enacted to mitigate gender discrimination, implicit gender bias persists in the workplace. Correspondingly, these challenges permeate against a backdrop of a crippling shortage of qualified engineers, and the high number of those who will retire within the next decade. To power future engineering and energy projects, it will require educators, policymakers, industry leaders, and philanthropists alike working collaboratively to infuse effective strategies that are drivers for pipelining talented female engineers. While the body of knowledge is extant around the shortage of women pursuing careers in science, technology, engineering, and mathematics (STEM) fields, the management literature has gaps regarding strategies successful female engineers employ to lead rewarding careers. The purpose of this research informed by Bandura's (1986) Self-Efficacy Theory is to understand the beliefs, attitudes, and outcome expectations of successful female engineers who experience barriers in the workplace.

KEYWORDS: Female engineer, career barriers, gender bias, a global economy, oil and gas company

Introduction

Females and the plight of their career paths have amassed a reasonable amount of interest in the management literature. This body of knowledge suggests female career development has been wrought with issues due to gender bias (Hatmaker 2012). Despite laws and statutes designed to protect marginalized populations from discrimination in the workplace, inequity persists especially against females (Hamel 2009). However, explicit gender discrimination in the work environment is perceived to be less evident following the enactment of the 1963 Equal Pay Act and the 1964 Civil Rights Act.

Notwithstanding, implicit workplace gender discrimination continues to permeate business and industry. Moreover, these implicit biases contribute to gender disparity during the recruitment, selection, and placement process in employment that inhibit a woman's ability to experience continuing success in the corporate arena (Hatmaker 2012). In the U.S., there is a dire need for innovation and ingenuity akin to developing creative engineering solutions to solve complex problems in a global economy (Hatmaker 2012). Furthermore, females are markedly underrepresented in science, technology, engineering, and mathematics (STEM) professions not only in the U.S. but, in many countries (Mozahem et al. 2019).

Interestingly, the number of female college graduates outnumber their male counterparts worldwide, yet females remain woefully underrepresented in STEM fields (Mozahem et al. 2019). Despite having earned college degrees as STEM majors from top universities, scholars of the World Economic Forum (2017) purport only 26% of jobs in the technology sector are performed by females (World Economic Forum, 2017). Correspondingly, the shortage of females employed in STEM professions is glaring on the international landscape (Mozahem et al. 2019).

Gender inequality and the plight of women in STEM fields have been issues concerning the political agenda of the United Nations Educational, Scientific and Cultural Organization (UNESCO 2016). The UNESCO in tandem with the STEM and Gender Advancement (SAGA) project, developed during the years 2015 to 2018, has emphasized delivering lawmakers and policymakers tools to mitigate gender disparity in STEM fields (UNESCO 2016). The scarcity of females in STEM professions is notably higher in the male-predominate field of engineering as compared to other STEM disciplines like mathematics and technology which makes this issue uniquely relevant to the literature (OECD 2015). Work initiatives that promote gender equity and the empowerment of

women and minorities are paramount to bolstering contemporary economies (UNESCO 2016). Although progress has been made within the past 20 years, this issue of too few women in STEM fields persists and continues to have detrimental effects on the U.S. economy and economies worldwide (UNESCO 2016).

The major research around this study concerns the challenges successful female engineers in the oil and gas industry face in their career trajectories. More importantly, it focuses on their perseverance and resilience in mitigating such challenges. In so much as an "engineer" is a problem-solver by nature, this study shows the problem-solving skills employed by female engineers when faced with adversity. From an empirical standpoint, to address this issue, Bandura's (1986) Self-Efficacy Theory serves as the theoretical underpinning that informs this research.

Strategies to Mitigate Barriers in the Workplace

In the male-dominated engineering field, oftentimes, females use innovative approaches to problem-solving to assuage adversity in a contemporary society that is diverse and multi-faceted (Hausman & Johnston, 2014). Female engineers are crucial in modern-day economies to maximize the growth and success of organizations (Hausman & Johnston 2014). The next section of this study highlights ongoing challenges faced by females in the workplace that further justifies the need for this research.

Structural hierarchies, deep-rooted norms, and stereotyping force females to hone their skills in mitigating career barriers (Hewlett & Luce 2005). Notwithstanding, defying workplace challenges can build resilience, oftentimes, allowing one to rise above adversity and grow from it (Hewlett & Luce 2005). Recent research around gender offers a glimpse of professional women as agentic, and despite roadblocks, effective at applying strategies to navigate their careers (Clec & Kels 2013). This depiction is in sharp contrast to prevailing perceptions and assumptions which characterize women as passive in mainstream management and organizational literature (Bendl 2008; Ely & Padavac 2007; Martin 2000). Furthermore, scholars and researchers have attributed the persistence of historical norms to the implicit reinforcement and adoption of a male perspective in the management literature (Khilji & Pumroy 2018). Although stereotypical roles and career barriers have persisted, females' self-perceptions have evolved. Therefore, given this shift, it is essential the career development of females be captured through their lived experiences in which emphasis is placed in tactics they employ to overcome career barriers (Khilji & Pumroy 2018).

Therefore, this study highlights strategies employed by female engineers that may be adopted to overcome the systemic vestiges of intolerance in the workplace and identify effective approaches that enable success in careers. In that vein, this research also provides a context for understanding the complexities faced by females in engineering versus science, technology, and mathematics.

The underrepresentation of females in the field of engineering has a far-reaching impact on the U.S. economy (U.S. Department of Education 2015). Moreover, many females who choose STEM fields often exit the profession in favor of gender-balanced careers. Therefore, an understanding of females' experiences may encourage the creation of strategies geared toward minimizing attrition in this male-dominated profession.

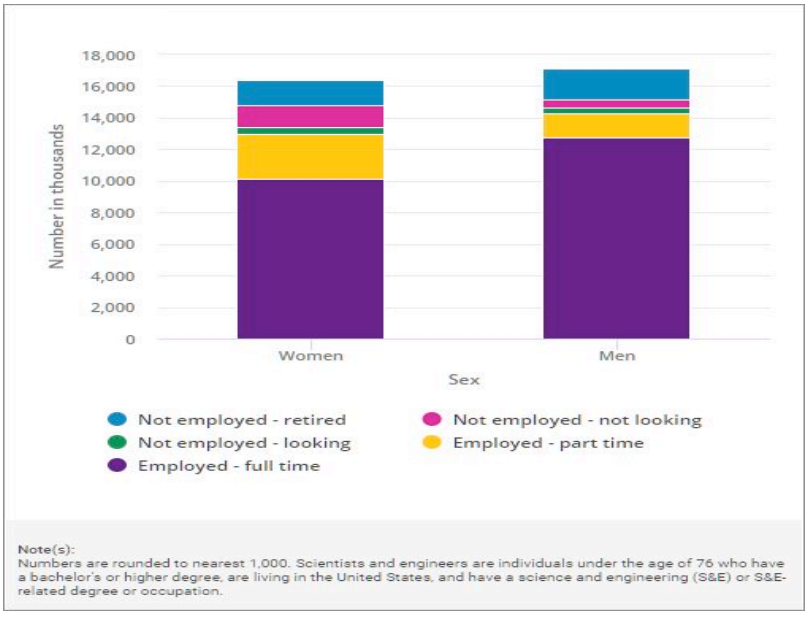
As mentioned earlier, Bandura's (1986) Self-Efficacy Theory informed this study as this theory seeks to interpret the beliefs and attitudes of female engineer professionals (Bandura 1986). Additionally, this theory is premised on the notion "psychological procedures, whatever their form, serve as a means of creating and strengthening expectations of personal efficacy" (p. 193). According to Bandura, self-efficacy beliefs and outcome expectations of individuals influence actions by acting indirectly on interests and choice goals (Hodkinson & Sparks 1997). Lent et al. (2013), suggest a social cognitive career perspective would help clarify career development and choices across the lifespan (Hodkinson & Sparks 1997). Put simply, motivation and self-efficacy are individuals' beliefs surrounding their capabilities to influence positive outcomes and employ strategies that prove effective in the lives they wish to lead. Self-Efficacy Theory describes how people are motivated, perceive their place in society, and their beliefs and values (Lent et al. 2000).

This paper is framed into seven segments in which the first section offers a review of the literature that suggests gender discrimination and bias has had a tremendous impact on females, especially in the work environment. In section two, there is an exploration of gendered profession barriers that are inherent in gender dominated fields followed by gender-based workplace statistics provided in section three. In section four titled, "Becoming an Insider" emphasis is placed on the need for females to experience a sense of belonging especially in male-dominated professions. In section five expect an introduction to a relatively new phenomenon "glass cliff" which offers examples of how females in leadership roles compared to their male counterparts in like roles are promoted to positions known to have had less than favorable performance outcomes. The sixth section provides insights from female engineer executives that show how they were tactical in mitigating pitfalls in the workplace when faced with gender bias. In the conclusion, it is suggested unique challenges require organizational leaders to employ inimitable strategies for managing subpopulations of talent.

Literature Review

In so much as females have increasingly earned more engineering bachelor's degrees compared to their male colleagues since 2000, their educational gains have not progressed equally in science and engineering arenas. Moreover, women persist in underrepresentation in upper-level positions in both academia and corporate America (Joshi 2014). For instance, in the corporate arena, female engineers in leadership roles lead teams with fewer employees compared to that of men (National Science Foundation 2018). At supervisory levels, females comprise nearly 9% of all engineering supervisors and roughly 12% of natural science supervisors relative to 20% of supervisors and approximately 16% of directors in other professions (National Science Foundation, 2018). Furthermore, irrespective of ethnicity, average annual salaries for female engineers were roughly 75% in comparison to their male colleagues (National Science Foundation 2018). Correspondingly, these statistics suggest, strides made by females in engineering have not boded well surrounding their advancement in the engineering workplace (Joshi 2014). In 2017, when comparing the employment status of female scientists and engineers, fewer females than males were employed full-time, and roughly twice as many females were employed part-time (National Science Foundation 2017). However, females often reported family responsibilities resulted in working part-time while men were generally retired (National Science Foundation 2017). See Table 1 for data on the status of scientists and engineers of employment by sex.

Table 1. Employment Status of Scientists and Engineers, by Sex: 2017



Source: National Science Foundation (2018), *Science and engineering indicators 2018*

Despite these statistics, this study considers how female engineers employ strategies to thrive and persevere in response to interactions in a male-predominate workplace. As such, data from interviews with female engineers and that of management literature show how these interactions influence feelings of belonging in engineering practitioners.

A Gendered Profession

Considering it was in 1892, a woman first earned an engineering degree in the U.S., progress has been far and in between (Sloan 1975). Moreover, there exists a continuing story in the literature regarding how women may or may not belong within the field of engineering, why the field of engineering is seemingly gender-biased against women, and how women identify with the engineering profession (Martin & Barnard 2013). Furthermore, much of this literature suggest gender-specific interactions in the workplace discourage women from thriving in the engineering profession (Martin & Barnard 2013).

Du Plessis and Barkhuizen (2012) centered their research on obstacles female engineers experience in the workplace. Moreover, findings from their studies conflate with large-scale research in that the following are barriers often debated (Du Plessis & Barkhuizen, 2012):

a) inadequate training and mentorship opportunities
b) ambiguity regarding pathways to integrate into the field of engineering
c) implicit gender bias and discrimination
d) continuous negative psychological experiences
e) blatant gender stereotyping
f) sentiments of under-utilization and low self-efficacy
g) consistently assigned to low priority projects
h) lack of work/life balance options

Extant research show, as a coping strategy, some women adopt masculine interaction styles (Kanter, 2020). Nonetheless, data show efforts to construct a professional identity, and feelings of belongingness are ambiguous. In using raw data from face-to-face, semi-structured interviews with female engineers, this study offers an analogous impact on management literature and underscores the implications of interactions in engineering culture. Furthermore, it illustrates females construct their identity in fields dominated by males by mitigating interactions that compromise their identity. Additionally, female engineers employ strategies to allay these occurrences to their sense of self and belonging in the profession of engineering. The next section highlights the statistics around the difficulty females face along their career trajectory to garner executive-level positions and earn comparable salaries to their male counterparts.

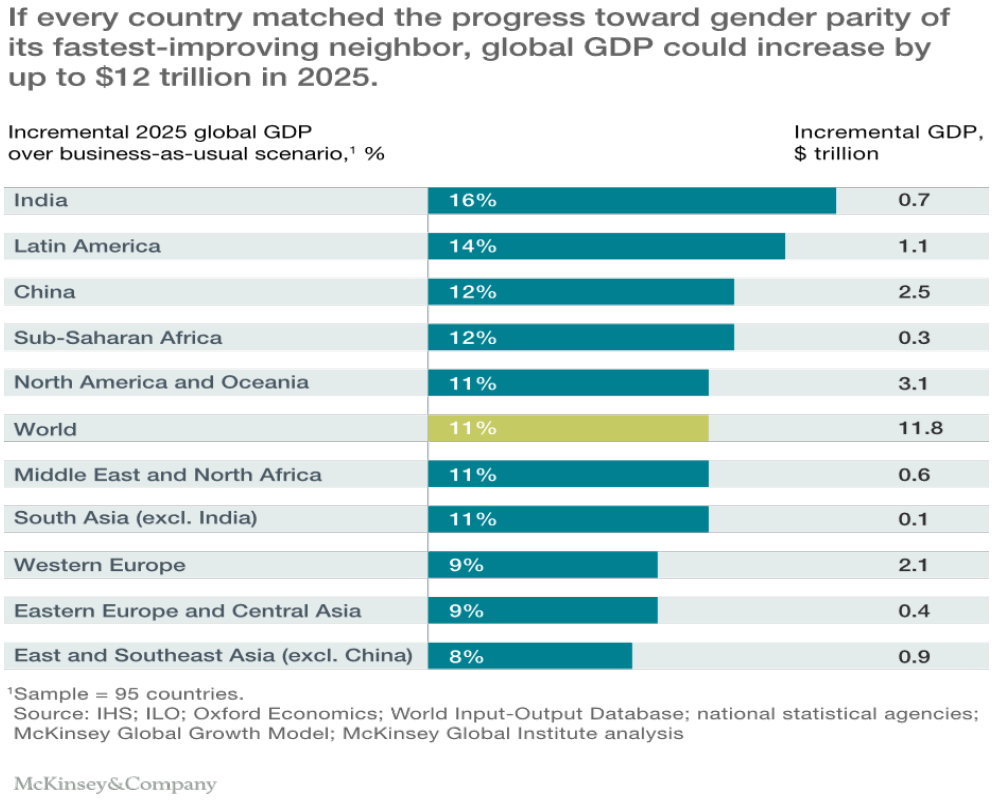
Gender-Based Workplace Statistics

When women are key players in the decision-making process of a team, performance outcomes tend to increase. Although the percentage of females in leadership positions at corporations has increased over the past 20 years, in recent times, progress has been slow. Moreover, the dearth of females in leadership roles is not due to a lack of education (Dworkin et al. 2018). By 2017, nearly 35% of women had earned a bachelor's degree or higher and in 2017 women completed graduate school at a rate higher than men (U.S. Census Bureau 2017). For example, in 1980 there was a low proportion of women in senior executive-level positions at Fortune 100 corporations, yet proportions increased to nearly 12% by 2002 (Warner 2014). From 1997 to 2009, board positions held by females in S&P 1500 corporations increased by roughly 95% (Warner 2014). According to the World Economic Forum's 2017 Gender Gap Index, females occupied roughly 17% of the board positions of companies in the U.S. that are publicly traded (The Global Gender Gap Report 2017).

Gender equality and the advancement of females in corporate leadership positions are noteworthy; however, progress is slow and inadequate. Similarly, industry leaders have been lacking in increasing the percentage of females that sit on corporate boards in recent years (The Global

Gender Gap Report, 2017). Moreover, in 2018, females occupied less than 22% of executive roles in North America, down from 23% in 2017. See Table 2, for a schema of the McKinsey Global Institute Growth Model.

Table 2. McKinsey Global Institute Growth Model



Source: McKinsey Global Institute Growth model (2015) *How advancing women's equality can add $12 trillion to global growth* [Image]. Permission granted to publish by McKinsey & Company.

Becoming an Insider

For females in engineering and other professions dominated by males, an overarching goal is to feel a sense of belonging (Hatmaker 2012). Females in fields dominated by males employ unique strategies for coping that positively affect their zeal to excel. Similarly, females in the engineering profession, construct their identity at work to become an insider, and gain a sense of belonging within multifaceted teams (Hatmaker 2012). Oftentimes, acceptance hinges on how well a female engineer's identity is perceived to be accepted among male peers (Hatmaker 2012). Therefore, constructing an identity in the workplace can be intensified by gender disparity that places a greater status on being a male engineer compared to a female engineer
(Hatmaker 2012).

The Glass Cliff Phenomenon

This section provides insight into hurdles female engineers experience in their quest for positions of leadership and the securing of prized assignments. In that vein, when females do succeed, such positions tend to be riskier than those garnered by men (Acar & Sumer, 2018). This form of bias is called "glass cliff" (Adams et al., 2015). Little research examines gender bias that contributes to glass cliff. Glass cliff is the phenomenon where females are slotted into roles and positions associated with less than favorable outcomes, while men are more likely to be groomed for high-level positions

associated with success (Bruckmüller et al., 2014). Therefore, the glass cliff phenomenon suggests female leaders compared to male leaders assume positions associated with poor performance, and therefore female leaders are held accountable for failure set in course before their promotions (Bruckmüller et al., 2014). Furthermore, due to glass cliff, the reputation of female leaders and their careers can ultimately be damaged (Bruckmüller et al, 2014). Other implications associated with glass cliff are a female's failure in a position where the risk of failure is greater, reinforces stereotypes that females are not befitting for roles of leadership (Bruckmüller et al, 2014).

Workplace Strategies Employed by Successful Female Engineers

This research shows successful female engineers developed high-performing teams and were astute at building closer relationships with customers given the increased connectivity for financial gains (Chou 2019). Having built careers with global corporations, these successful female engineers were keen at reading the "tea leaves" as they had many years of experience living in countries overseas in both developed and emerging economies (Houston 2019). The ability of these engineers to adjust leadership styles and approaches depending on the team or issue was a strength honed through experience, expanded skills, and high-self-efficacy (Houston 2019). Similarly, the "depth and breadth" in which these engineers approached leadership was evident in how they carefully selected and hired those who demonstrated high emotional intelligence, were experts in varying technologies, and boded financial experience. Additionally, successful engineer leaders were in keeping with trends and changing systems, be they companies, industries, countries, or global societies.

Notwithstanding, drivers surrounding moral and ethical issues were a highpoint for female engineers with successful careers as they provided unique perspectives to the decision-making process as members of a historically marginalized group, i.e., each of the engineer executives shared their "lived experiences" as females building careers in an inordinately male-dominated industry (Houston 2019). For example, findings unearthed scenarios in which they were commonly overlooked for promotions to not garnering projects global in scope to gender pay disparity to working within a hostile environment (Houston 2019). Yet each was undaunted and found their "voices" along their career trajectories (Houston 2019).

Conclusions

The successful retention of human capital in the global workplace has been affected by unprecedented changes in labor force demographics. These unique challenges require industry leaders to employ effective strategies for managing subpopulations of talent (World Economic Forum 2017). The disparity is apparent horizontally as exemplified by females working with individuals and males with objects and things (Blackburn & Jarman 2006). And, vertically with males dominating superior positions across sectors (Blackburn & Jarman 2006). This is true even in relatively gender-equal countries (World Economic Forum 2017). Thus, the persistent discord between males and females regarding equity in the workplace presents unique opportunities for leaders to ensure full participation of women and other underrepresented groups especially at oil and gas companies and the global STEM workforce (Houston 2019).

When devising organizational policy, corporate leaders would do well to emphasize the importance of mentoring and advocacy programs for women to help level the playing field and offer gender bias training for males. Furthermore, industry leaders can mandate improvements to the work environment for women by creating family-friendly policies. Not only would these changes be praiseworthy, they will likely increase performance and prove significant in resolving the paradox surrounding the shortage of females in the engineering profession (Dworkin et al. 2018).

References

Acar, F. P., & Sumer, H. C. 2018. "Another test of gender differences in assignments to precarious leadership positions: Examining the moderating role of ambivalent sexism." https://www.researchgate.net/publication/323013842_Another_Test_of_Gender_Differences_in_Assignments_to_Precarious_Leadership_Positions_Examining_the_Moderating_Role_of_Ambivalent_Sexism_Glass_Cliff_and_Ambivalent_Sexism.

Adams, S. M., Flynn, P. M., & Wolfman, T. G. 2015. "Orchestrating the demise of allmale boards." *Journal of Management Inquiry 24:* 208–211. https://doi.org/10.1177/1056492614546264.

Bandura, A. 1986. "Prentice-Hall series in social learning theory. Social foundations of thought and action: A social cognitive theory." Prentice-Hall, Inc.

Bendl, R. 2008. "Gender subtexts—Reproduction of exclusion in organizational discourse." *British Journal of Management 19*(1): 50–64. https://doi.org/10.1111/j.1467-8551.2008.00571.x.

Blackburn, R. M., & Jarman, J. 2006. "Gendered occupations exploring the relationship between gender segregation and inequality." *International Sociology 21*(2): 289-315. https://doi.org/10.1177/0268580906061380.

Bruckmüller, S., Ryan, M.K., Rink, F., & Haslam, S.A. 2014. "Beyond the glass ceiling: The glass cliff and its lessons for organizational policy." *Social Issues and Policy Review, 8,* 202–232. https://doi.org/10.1111/sipr.12006.

Chou, S.-Y. 2019. "The fourth industrial revolution: Digital fusion with internet of things." *Journal of International Affairs 72*(1): 107-120. https://www-jstor-org.lib.pepperdine.edu/stable/26588346?seq=1#metadata_info_tab_contents.

Clerc, I., & Kels, P. 2013. "Coping with career boundaries in masculine professions: Career politics of female professionals in the ICT and energy supplier industries in Switzerland." *Gender, Work and Organization 20*(2): 197–210. https://doi.org/10.1111/gwao.12017.

DuPless, Y., & Barjhuizen. 2012. **"**Psychological capital, a requisite for organizational performance in South Africa." *South African Journal of Economic and Management Sciences 15*(1). https://doi.org/10.4102/sajems.v15i1.122.

Dworkin, T. M., Schipani, C. A., Milliken, J. F., & Kneeland, M. K. 2018. "Assessing the progress of women in corporate America: The more things changes, the more they stay the same." *American Business Law Journal (55)*4: 721–762. https://doi.org/10.1111/ablj.12132.

Ely, R., & Padavac, I. 2007. "A feminist analysis of organizational research on sex differences." *Academy of Management Review 32*(4): 1121–1143. https://doi.org/10.5465/amr.2007.26585842.

Hamel, S. A. 2009. "Exit, voice, and sensemaking following psychological contract violations: Women's responses to career advancement barriers." *The Journal of Business Communication 46*(2): 234–261. https://doi.org/10.1177/0021943608328079.

Hatmaker, D. 2012. "Engineering identity: Gender and professional identity negotiation among women engineers." *Gender, Work and Organization 20*(4): 382–396. https://doi.org/10.1111/j.1468-0432.2012.00589.x.

Hausman, A., & Johnston, W. J. 2014. "The role of innovation in driving the economy: Lessons from the global financial crisis." *Journal of Business Research 67*(1): 2720-2726. https://ideas.repec.org/a/eee/jbrese/v67y2014i1p2720-2726.html.

Hewlett, S. A., & Luce, C. B. 2005. "Off-ramps and on-ramps: Keeping talented women on the road to success." *Harvard Business Review, 83*(3): 43–54. https://hbr.org/2005/03/off-ramps-and-on-ramps-keeping-talented-women-on-the-road-to-success.

Hodkinson, P., & Sparks, A. C. 1997. "Careership: A sociological theory of career decision making." *British Journal of Sociology of Education 18*(1): 29-44. https://eric.ed.gov/?id=EJ571097.

Houston, T. 2019. STEM pathways: Factors that inspire women to pursue careers in science, technology, engineering, and mathematics (Doctoral dissertation).

ProQuest Dissertations and Theses. (Accession 22587272). https://search proquest-com.lib.pepperdine.edu/docview/2287496028?accountid=13159.

Joshi, A. 2014. "By whom and when is women's expertise recognized? The interactive effects of gender and education in science and engineering teams." *Administrative Science Quarterly 59*(2): 202–39. doi:10.1177/0001839214528331.

Kanter, R. M. 2020. "Some effects of proportions on group life: Skewed sex ratios and responses to token women." *American Journal of Sociology 82*(5): 1977 965–990. https://www.jstor.org/stable/2777808?seq=1.

Khilji, S. E., & Pumroy, K. H. 2018. "We are strong and we are resilient: Career experiences of women engineers." *Gender, Work, and Organization 26:* 1032 – 1052. https://doi.org/10.1111/gwao.12322.

Lent, R. W., Brown, S., & Hackett, G. 2002. "Conceptual supports and barriers to career choice. A social cognitive analysis." *Journal of Counseling Psychology 47:* 36-49. DOI: 10.1037/0022-0167.47.1.36.

Martin, J. 2000. "Hidden gendered assumptions in mainstream organizational theory and research." *Journal of Management Inquiry 9*(2): 207–216. https://doi.org/10.1177/105649260092017.

Martin, P., & Barnard, A. 2013. "The experience of women in male-dominated occupations: A constructivist grounded theory inquiry." *South Africa Journal of Industrial Psychology 39*(2): 1-12. http://dx.doi.org/10.4102/sajip.v39i2.1099.

McKinsey Global Institute Growth Model. 2015. *How advancing women's equality can add $12 trillion to global growth* [Image]. www.mckinsey.com/featured-insights/employment-and-growth/how-advancing-womens-equality-can-add-12-trillion-to-global-growth. Permission granted to publish by McKinsey & Company.

Mozahem, N. A., Ghanem, C. M., Hamieh, F. K., & Shoujaa, R. E. 2019. *Women in engineering: A qualitative investigation of the contextual support and barriers to their career choice*. https://doi.org/10.1016/j.wsif.2019.03.014.

National Science Foundation. 2017. *Women, minorities, and persons with disabilities in science and engineering*. https://ncses.nsf.gov/pubs/nsf19304/digest/employment.

National Science Foundation. 2018. *Science and engineering indicators 2018*. https://www.nsf.gov/statistics/2018/nsb20181/report/sections/science-and-engineering-labor-force/women-and-minorities-in-the-s-e-workforce.

OECD. 2015. *The abc of gender equality in education: Aptitude, behaviour, confidence*. http://dx.doi.org/10.1787/9789264229945-en

Sloan, M. E. 1975. *Opportunities for women in engineering*. *IEEE transactions on education,* E-18, 1-2. https://scholar.google.com/scholar_lookup?hl=en&volume=E-18&publication_year=1975&pages=12&author=M.+E.+Sloan&title=Opportunities+for+women+in+engineering.

The Global Gender Gap Report 2017. *Women on corporate boards*. http://www.catalyst.org/knowledge/women-corporate-boards-globally.

UNESCO. 2016. *STEM and gender advancement (SAGA): Improving measurement and policies for gender equality in STEM* [A Global UNESCO Project]. http://www.unesco.org/new/en/natural-sciences/priority-areas/gender-andscience/improving-measurement-of-gender-equality-in-stem/stem-and-genderadvancement-saga/.

U.S. Census Bureau. 2017. *Educational attainment in the United States*. https://census.gov/data/tables/2017/demo/education-attainment/cps-detailed-tables.html.

U.S. Department of Education. 2015. *Science, technology, engineering, and mathematics: Education for global leadership*. https://www.techedmagazine.com/science-technology-engineering-and-math-education-for-global-leadership/

Warner, J. 2014. *Fact sheet: The women's leadership gap*. https://www.americanprogress.org/issues/women/report/2014/03/07/85457/fact-sheet-the-womens-leadership-gap/.

World Economic Forum. 2017. *The global gender gap report*. https://www.weforum.org/reports/the-global-gender-gap-report-2016.