

Perception vs. Parity: Evaluating Gendered Competencies and Hiring Decisions in the Engineering Industry

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ABSTRACT

This empirical research investigates the persistence of gender-based workplace stereotypes, perceived operational competencies, and recruitment preferences within the engineering and technical construction sectors ($N = 70$; 60.0% male, 40.0% female). Utilizing a cross-sectional, mixed-methods research design, quantitative data gathered from a 16-item, 7-point Likert scale were evaluated using descriptive statistics, independent samples t -tests, non-parametric Mann-Whitney U tests, and Cohen's d effect sizes, complemented by thematic analysis of open-ended candidate selection scenarios ($n = 58$) and qualitative commentary. The findings reveal a strong perceptual convergence on software and technical tool usage ($\mu = 4.31, p = 0.5147$), confirming that technical competence is recognized as gender-neutral. However, statistically significant subgroup differences ($p < 0.05$) emerged across 14 operational dimensions, where physical strength ($\mu = 5.74$) and site suitability were heavily male-favored, reinforcing a structural "Site vs. Office" dichotomy. Consequently, male candidates were explicitly preferred in 50.0% of recruitment scenarios, compared to just 8.6% for female candidates. Male respondents exhibited significantly higher male-favourable bias than females, most prominently regarding perceived post-maternity/marriage resignation risk ($\Delta = +1.25, p = 0.0010, d = 0.84$), reflecting statistical discrimination among decision-makers regarding family commitments—a premise strongly rejected by female engineers. Although 41.4% of participants advocated for meritocratic, context-dependent hiring, systemic bias continues to dictate task allocation and limit female field leadership experience. To foster equity, engineering organizations must adopt anonymized resume screening, structured competency rubrics, equitable field rotation pipelines, and output-based performance evaluations.

Keywords: Gender Bias, Occupational Segregation, Engineering Recruitment, Workplace Stereotypes, Statistical Discrimination

INTRODUCTION

The engineering and construction industry remains a highly gender-segregated sector. Although women's participation in science, technology, engineering and mathematics (STEM) education and employment has increased, women continue to be underrepresented in engineering and construction occupations, particularly in technical, site-based and skilled-trade roles. Recent international evidence indicates that women represent less than 40% of engineering employees in many countries, while construction and engineering remain among the STEM areas with the largest gender disparities (Cheryan et al., 2025).

This pattern should not be interpreted as evidence of lower female technical ability. Research indicates that women's underrepresentation is associated with a combination of structural, cultural and institutional factors, including masculine workplace cultures, limited access to professional networks, gender stereotypes, unequal career opportunities and difficulties reconciling long or unpredictable working hours with family responsibilities. Studies of women in construction have similarly identified workplace culture, career structures and work-life expectations as important influences on women's career advancement and retention (Cheryan et al., 2025; Fernando et al., 2014; Francis, 2017; Lingard et al., 2008; Watts, 2009).

Gender stereotypes are particularly influential in field-based engineering and construction environments. Site supervision, contractor management and project leadership are often associated with assertiveness, physical toughness, risk-taking, emotional control and the ability to work long or irregular hours. These characteristics are culturally constructed as masculine, which can cause male practitioners to be perceived as more naturally suited to site leadership than female practitioners. Ness (2012), for example, demonstrates how masculine identities and "hard-hat" cultures are reproduced within the building trades, while Watts (2009) shows how work-life expectations shape the experiences of female civil engineers.

Women engineers may therefore experience a double standard in relation to professional behaviour. When they demonstrate assertiveness and authority, they may be judged as unfeminine, aggressive or difficult; when they demonstrate interpersonal sensitivity and collaboration, they may be perceived as lacking the toughness or authority associated with site leadership. This pattern is consistent with research on gender-role congruity, which shows that women can be evaluated negatively when their gender identity is perceived to conflict with the requirements of a traditionally masculine leadership role (Eagly & Karau, 2002; Garcia-Retamero & López-Zafra, 2006).

These perceptions may affect recruitment, work allocation, access to field experience, promotion and long-term retention. In particular, the unequal allocation of site-based responsibilities may restrict women's opportunities to acquire the operational experience required for senior project-management and executive positions. Research on women's career advancement in construction suggests that career progression is influenced not only by qualifications and individual performance but also by workplace culture, organizational support, mentoring, work-life arrangements and access to career-enhancing assignments (Fernando et al., 2014; Francis, 2017).

Statistical Discrimination Theory provides a further explanation for how such disadvantages may arise during recruitment. Under conditions of incomplete information, employers may rely on perceived group-level characteristics rather than evaluating every applicant solely on individual qualifications (Arrow, 1973; Phelps, 1972). In engineering and construction, this may encourage assumptions that female applicants will be less willing or able to work extended hours, undertake remote site assignments or remain in the industry after marriage or parenthood. Such assumptions may produce a recruitment disadvantage even when female and male applicants have comparable academic qualifications and professional experience. These claims should, however, be examined empirically rather than treated as established facts in every engineering organization.

Understanding these perceptions among current engineering and construction practitioners is therefore important for developing targeted organizational interventions. Existing research has documented women's underrepresentation and the broader barriers affecting their participation in STEM and construction. However, further research is needed to examine whether male and female engineers differ in their perceptions of women's operational capability, career longevity, suitability for site-based work and treatment during recruitment. This study addresses that gap by examining gender-based perceptions within technical engineering firms.

THEORETICAL BACKGROUND

This study is grounded in three complementary theoretical frameworks that explain how gender stereotypes translate into structural career barriers within male-dominated industries:

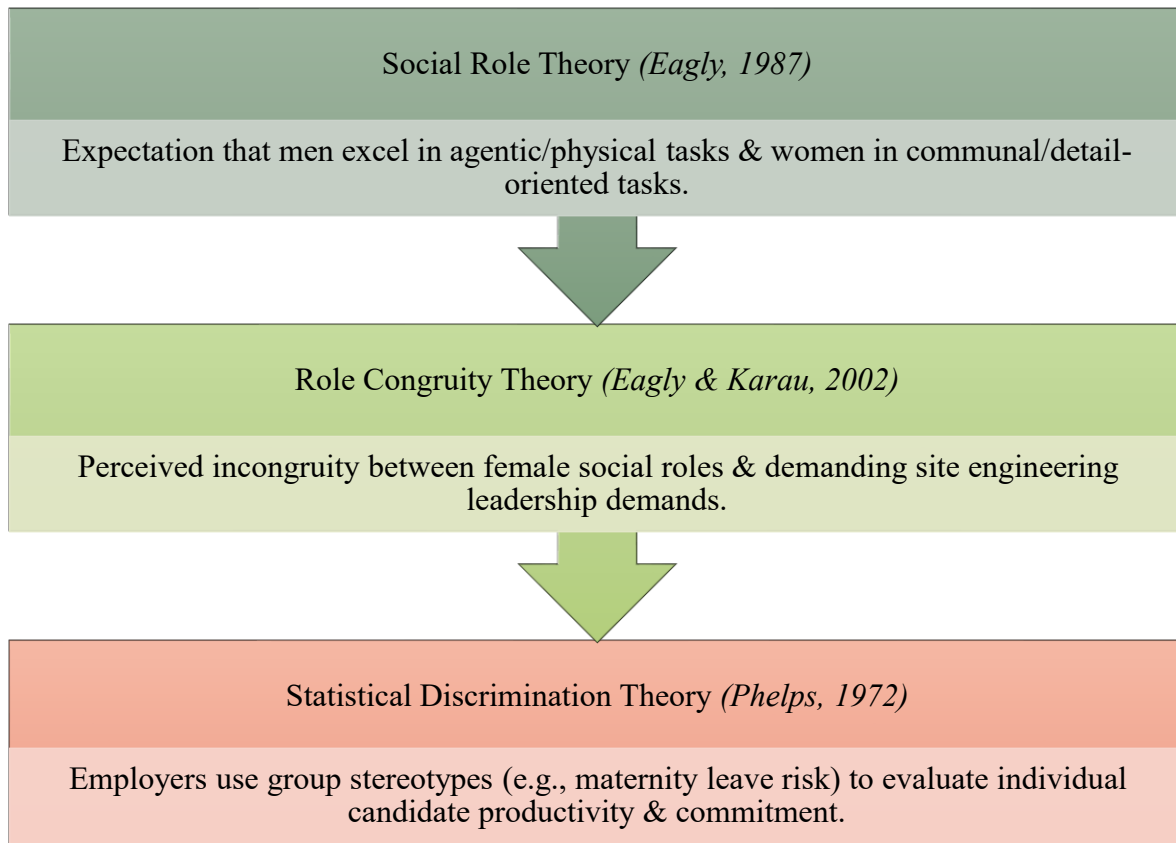


Figure 1: Theoretical framework linking social roles, role congruity and statistical discrimination to gender-based workplace perceptions.

Social Role Theory proposes that gender stereotypes develop partly from the historical division of labour between women and men (Eagly, 1987; Eagly & Wood, 2012). When women and men are observed performing different social and occupational roles, these patterns may be generalized into expectations about the characteristics associated with each gender. Women are commonly stereotyped as communal, cooperative, caring and relationship-oriented, whereas men are more often stereotyped as agentic, assertive, independent and risk-oriented (Eagly & Johannesen-Schmidt, 2001).

These characteristics should be understood as socially attributed expectations rather than innate differences between women and men. In construction and engineering, agentic characteristics are often associated with site supervision, technical authority, contractor negotiation and crisis management. Consequently, organizational decision-makers may unconsciously interpret masculine-coded behaviours as evidence of leadership potential while undervaluing collaborative or relational forms of leadership.

Role Congruity Theory extends Social Role Theory by explaining how prejudice can arise when the expected characteristics of a social group conflict with the requirements of a professional role (Eagly & Karau, 2002). Leadership and site-management positions in construction are frequently associated with assertiveness, authority, physical endurance, risk tolerance and emotional control. Because these characteristics are commonly stereotyped as masculine, women may be perceived as less suitable for such positions before their actual competence is fully assessed.

This creates a potential double bind for female engineers. A woman who adopts an assertive leadership style may violate expectations of feminine interpersonal behaviour and be judged negatively. Conversely, a woman who emphasizes cooperation, consultation and interpersonal sensitivity may be judged as insufficiently authoritative or resilient for a demanding site environment. Evidence on prejudice toward women in male-congenial leadership environments supports the argument that evaluations may be shaped by perceived compatibility between gender roles and occupational roles (Garcia-Retamero & López-Zafra, 2006).

Role Congruity Theory is therefore useful for examining perceptions of women's operational capability, leadership potential and suitability for field-based engineering work. It also helps explain why identical behaviours may be interpreted differently depending on whether they are performed by a male or female engineer.

Statistical Discrimination Theory explains how employers may use perceived group-level information when they have limited information about an individual applicant (Arrow, 1973; Phelps, 1972). Instead of evaluating candidates exclusively on qualifications, experience and demonstrated performance, recruiters may rely on assumptions about the average characteristics of women and men.

In technical engineering firms, such assumptions may concern women's willingness to work overtime, availability for remote or difficult site assignments, likelihood of taking career breaks or expected length of employment. Even where these assumptions are inaccurate for a particular applicant, they may influence recruitment, placement and promotion decisions. The result may be an unequal opportunity to obtain the field experience needed for advancement.

This theory is particularly relevant to the present study because it connects workplace perceptions with organizational decision-making. It allows the study to examine whether male and female practitioners differ in their views of women's availability, operational commitment, career longevity and suitability for technical or site-based roles. It also provides a framework for distinguishing between judgments based on an individual's demonstrated qualifications and judgments based on assumptions about women as a group.

The three theories explain different stages of the same process (Figure 1). Social Role Theory explains how gendered expectations are formed; Role Congruity Theory explains why women may be evaluated negatively in masculine-coded engineering roles; and Statistical Discrimination Theory explains how these assumptions may influence recruitment and assignment decisions. Together, the theories provide a framework for investigating how gender perceptions may contribute to occupational segregation, unequal access to field experience and differences in career progression within engineering and construction organizations.

Research Problem

Although technological developments such as engineering software, automated equipment and building information modelling have changed the organization of engineering and construction work, gendered assumptions about technical and field-based occupations continue to influence workplace expectations. Construction work is often associated with physical strength, toughness, long working hours and the ability to tolerate difficult site conditions. These characteristics are frequently treated as indicators of professional suitability, even though many contemporary engineering tasks depend primarily on technical knowledge, coordination, communication and problem-solving skills (Ness, 2012; Watts, 2009).

Gendered expectations may also influence how engineering roles are allocated within organizations. Female engineers may be more frequently associated with design, consultancy, planning, regulatory approval and administrative responsibilities, whereas male engineers may be perceived as more suitable for construction-site supervision, field management and remote or outstation assignments. This form of occupational differentiation is important because access to site-based work can provide engineers with practical leadership experience, contractor-management skills and project responsibility. Such experience may influence later opportunities for promotion and senior project-management roles (Fernando et al., 2014; Francis, 2017).

The problem is not necessarily a lack of qualifications or technical competence among female engineers. Rather, organizational perceptions may shape how their competence, availability, career commitment and suitability for field-based work are evaluated. Research on women's career progression in construction identifies workplace culture, long-hours expectations, limited flexibility, unequal access to career-enhancing opportunities and gendered assumptions about professional commitment as continuing barriers to advancement (Fernando et al., 2014; Francis, 2017; Lingard et al., 2008; Watts, 2009).

These perceptions may affect recruitment and assignment decisions. From the perspective of Statistical Discrimination Theory, employers operating under conditions of incomplete information may rely on perceived group characteristics when evaluating candidates, rather than assessing each applicant entirely on individual qualifications (Arrow, 1973; Phelps, 1972). In engineering organizations, this may result in assumptions that female applicants are less willing to work overtime, accept remote site assignments or remain in demanding field-based roles. Such assumptions may disadvantage women even when they possess qualifications and experience comparable to those of male applicants.

Accordingly, the research problem addressed in this study is the persistence of gender-based perceptions in the recruitment, assignment and career development of engineering and technical professionals. The study uses survey data from male and female practitioners to examine the extent to which gender stereotypes influence perceptions of women's operational capability, suitability for site-based work, willingness to undertake demanding assignments and potential for long-term career progression. It also investigates whether male and female practitioners differ in their perceptions and whether these perceptions are associated with recruitment preferences.

Research Objectives and Hypotheses

The overarching objective of this study is to systematically examine gender perceptions and recruitment behaviours within engineering firms. Specifically, the research addresses four key domains. First, it evaluates industry perceptions regarding the technical, physical, and operational competencies of male and female engineering professionals. Second, it identifies statistically significant subgroup differences between genders concerning workplace performance, problem-solving independence, emotional resilience, and turnover propensity. Third, the study quantifies recruitment preferences when selecting between equally qualified male and female candidates. Finally, it qualitatively explores structural barriers—such as the "site versus office" dichotomy and maternity-related statistical discrimination—that shape female career trajectories in engineering.

Based on the theoretical framework, this study tests three central hypotheses regarding gender evaluations, bias, and recruitment decisions. First (H_1), technical tool and engineering software competencies are hypothesized to be evaluated as gender-neutral, showing no statistically significant differences between male and female respondents. Second (H_2), male respondents will demonstrate a significantly higher endorsement of male superiority across operational, physical, and stress-resilience attributes compared to female respondents, reflecting in-group perception bias. Finally (H_3), recruitment choices for identical candidate profiles are predicted to exhibit a significant bias toward male applicants, primarily rationalized by site environmental conditions and overtime availability.

METHODOLOGY

Research Design and Data Collection Method

Questionnaire Design

A structured questionnaire was designed as the primary quantitative and qualitative data collection instrument to capture empirical insights directly from industry practitioners. The questionnaire comprises 26 comprehensive items developed in English. The instrument is organized into three distinct sections; Section A: Captures demographic and organizational characteristics of the respondents, including gender, marital status, job designation, company type, sector, company tenure, and total industry experience; Section B: Evaluates practitioner perceptions regarding gender-based workplace competencies, operational capabilities, socio-emotional resilience, physical endurance, and institutional turnover risks; Section C: Identifies crucial recruitment decision factors and hiring preferences when evaluating equally qualified male and female engineering candidates for technical roles.

The survey items were formulated based on a thorough content analysis of the existing literature on Social Role Theory, Role Congruity Theory, and Statistical Discrimination. A seven-point Likert scale—ranging

from 1 ("Strongly Disagree") to 7 ("Strongly Agree")—was used to measure all continuous perception variables in Section B.

Validity and Reliability of Instrument

To establish content validity, the questionnaire was reviewed and validated by an expert panel, including an Associate Professor from the Faculty of Civil Engineering, Universiti Teknologi MARA (UiTM), Shah Alam, Malaysia. Based on expert feedback, revisions were made to the wording, technical terms, and structural flow to enhance clarity and streamline the question sequence. Prior to full administration, a pilot test was conducted with 30 randomly selected industry respondents to assess item clarity, relevance, and completion time. Cronbach's alpha coefficients were calculated to verify internal consistency reliability.

Questionnaire Survey and Sampling Procedure

A non-probability, purposive sampling strategy combined with convenience sampling was employed to recruit qualified engineering and construction practitioners across public and private sectors in Malaysia. Inclusion criteria required respondents to: (a) hold a recognized tertiary qualification in an engineering or technical construction discipline, (b) possess a minimum of one year of active industry experience, and (c) hold current employment within a consulting, contracting, client, or government organization.

Target organizations were identified via regional industry registries across the Johor construction hubs. The survey was manually distributed across 115 targeted engineering offices and active construction project sites between June and November 2024. A total of 100 questionnaire packages were distributed, yielding 70 fully completed and audited responses ($N = 70$; 70.0% response rate). Questionnaires with incomplete Likert evaluation fields were excluded prior to statistical processing.

Measurement Instrument and Data Structure

The questionnaire was structured into three primary analytical sections to systematically capture quantitative and qualitative data. The first section gathered demographic and professional profiles, including respondent gender, marital status, job designation, company sector, company tenure, and total industry experience.

The second section quantitatively evaluated perceived gender competencies using Likert-scale items ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). Higher scores denoted stronger agreement with statements asserting male superiority or favourability across operational, technical, emotional, and social attributes. Specific dimensions assessed included physical strength, mental resilience, independent problem-solving, overtime availability, software tool proficiency, and post-maternity or marriage attrition risk.

Finally, the third section employed a mixed-methods design to assess recruitment decisions and collect qualitative commentary. This section presented a hypothetical candidate selection scenario evaluating hiring choices between two equally qualified candidates—one male and one female—and included open-ended fields to qualitatively probe perceptions regarding gender discrimination and structural challenges faced by female engineers in the field.

Quantitative Analytical Procedures

Data were audited in Microsoft Excel and processed using SPSS (version 22.0) and Python (pandas, scipy.stats). Skewness values across all 16 Likert variables fell within the acceptable range of -2.0 to $+2.0$, confirming univariate normality. The analytical pipeline proceeded through three sequential stages:

Descriptive Statistics and Univariate Analysis

Group means (μ), standard deviations (SD), and raw mean differences ($\Delta = \mu_{\text{Male}} - \mu_{\text{Female}}$) were computed across all 16 perception items for the total sample as well as gender-disaggregated subgroups ($n_{\text{Male}} = 42$, $n_{\text{Female}} = 28$).

Hypothesis Testing and Subgroup Differences

To test for statistically significant differences in perceptions between male and female practitioners:

- Levene's Test for Equality of Variances was conducted to verify homoscedasticity assumptions across groups (Levene, 1960).
- Two-Sample Independent t -Tests (parametric) were performed for each Likert item (Student, 1908; Field, 2018). The test statistic t was calculated as:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

- Mann-Whitney U Tests (non-parametric) were calculated concurrently to cross-validate results against potential ordinal skewness and unequal group sizes (Mann & Whitney, 1947).
- Statistical significance was evaluated at thresholds of $p < 0.05^*$, $p < 0.01$, and $p < 0.001^{***}$.

While conducting multiple univariate comparison tests risks inflating Type I error rates, raw unadjusted p -values were deliberately retained in Table 3A and 3B based on the exploratory and domain-specific nature of this study. Per recommendations by Rothman (1990) and Saville (1990), overly conservative multiplicity adjustments (such as the Bonferroni method) substantially increase Type II error rates, potentially masking genuine operational disparities in applied organizational research. Each item in the 16-variable instrument measures a distinct, non-redundant behavioural construct (e.g., physical strength versus post-maternity resignation risk). Rather than relying strictly on adjusted alpha thresholds, practical significance and meaningful subgroup divergence were primarily established using Cohen's d effect size estimations ($d \geq 0.50$) alongside 95% confidence intervals of mean differences.

Effect Size Estimation

To evaluate the practical magnitude of perceptual gaps beyond p -values, Cohen's d was calculated using the pooled standard deviation (S_{pooled}):

$$d = \frac{\bar{X}_{\text{Male}} - \bar{X}_{\text{Female}}}{S_{\text{pooled}}}$$

where $S_{\text{pooled}} = \sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1 + n_2 - 2}}$. Effect sizes were interpreted following standard conventions: $d \approx 0.2$ (small), $d \approx 0.5$ (medium), and $d \geq 0.8$ (large) (Cohen, 1988).

Qualitative Content and Thematic Analysis

The open-ended narrative data ($n = 58$ valid responses for candidate selection, $n = 53$ for discrimination comments, $n = 31$ for field comments) were analysed using Braun and Clarke's (2006, 2019) thematic analysis framework:

1. Text Parsing & Recoding: Candidate preference choices were parsed and categorized into three mutually exclusive categories: (a) *Male Candidate Preferred*, (b) *Depends / Merit / Role Context*, and (c) *Female Candidate Preferred*.
2. Inductive Coding: Open-ended remarks were independently reviewed to generate initial codes regarding operational constraints, site culture, overtime demands, and gender assumptions.

3. Theme Synthesis: Codes were aggregated into overarching qualitative themes, notably the spatial segregation between site/field roles and office/consultant functions.

RESULTS AND DISCUSSION

Cronbach's Reliability Test

The reliability coefficients for the research constructs are presented in Table 1. Reliability testing evaluates measurement consistency and stability, which is essential for ensuring statistical validity and empirical rigor. In academic literature, Cronbach's alpha values below 0.60 indicate poor reliability, values around 0.70 represent good reliability, and values exceeding 0.80 reflect very good to excellent internal consistency. Values above 0.90 denote an exemplary standard (Sekaran & Bougie, 2016).

Following pilot testing and full data collection ($N = 70$), the overall 16-item scale yielded an excellent Cronbach's alpha of 0.946. All sub-construct dimensions exhibited reliability coefficients ranging from 0.870 to 0.878, comfortably exceeding the recommended 0.80 threshold. These results confirm high internal consistency, and no items required removal.

Table 1: Reliability Testing Results ($N = 70$)

Construct / Variable Subscale	Number of Items	Cronbach's Alpha (α)	Internal Consistency Level
Operational & Physical Competence	6	0.870	Very Good
Socio-Emotional Resilience	5	0.870	Very Good
Professional Independence & Attrition Perception	5	0.878	Very Good
Overall Gender Competency Instrument (Section B)	16	0.946	Excellent

Sample Demographics and Respondent Profile

The respondent sample ($N = 70$) comprises 60.0% male ($n = 42$) and 40.0% female ($n = 28$) practitioners. The majority operate in the private sector (65.7%, $n = 46$), followed by the public sector (34.3%, $n = 24$). Participants hold various technical roles: Supervisors (34.3%, $n = 24$), Heads of Department (24.3%, $n = 17$), Others (22.9%, $n = 16$), Managers (15.7%, $n = 11$), and Vice Managers (2.9%, $n = 2$). Industry experience is well-distributed: 1–5 years (31.4%, $n = 22$), 6–10 years (27.1%, $n = 19$), 11–15 years (25.7%, $n = 18$), and over 15 years (15.7%, $n = 11$) (Table 2).

Table 2: Respondent Demographic Profile ($N = 70$)

Demographic aspect	Items	Frequency (n)	(%)
Gender	Male	42	60.0
	Female	28	40.0
Sector	Public	24	34.3
	Private	46	65.7
Designation	Manager	11	15.7
	Vice Manager	2	2.9
	Head Of Department	17	24.3
	Supervisor	24	34.3
	Others	16	22.9
Industry working experience	1 to 5 years	22	31.4
	6 to 10 years	19	27.1
	11 to 15 years	18	25.7
	15 years and above	11	15.7

Comparative Analysis of Gender Perceptions

To evaluate whether gender-based workplace stereotypes persist in the engineering sector, responses across 16 Likert-scale items (1 = Strongly Disagree to 7 = Strongly Agree that men are superior) were examined. Table 3 presents the overall sample means, subgroup means by respondent gender, mean differences ($\Delta = \mu_{\text{Male}} - \mu_{\text{Female}}$), independent samples *t*-test results, and effect sizes (Cohen's *d*).

As shown in Table 3A and 3B, full descriptive metrics—including group standard deviations and 95% confidence intervals for mean differences—were computed across all 16 items. Confidence intervals for statistically significant items (e.g., Resignation Risk 95% CI = [0.52, 1.98]) exclude zero, confirming robust subgroup divergence between male and female engineering practitioners.

Table 3A: Descriptive Statistics, *t*-Tests, Effect Sizes, and 95% Confidence Intervals for Perceived Gender Competencies (*N* = 70)

Survey Item / Dimension	Overall Mean (μ)	Male Mean (μ_{Male})	Male SD	Female Mean (μ_{Female})	Female SD	Mean Diff (Δ)	95% CI of Diff
Physical Strength	5.74	6.07	1.00	5.25	1.27	+0.82	[0.27, 1.37]
Control Emotions	5.24	5.50	1.15	4.86	1.38	+0.64	[0.03, 1.25]
Mentally Stronger	4.94	5.38	1.38	4.29	1.74	+1.10	[0.35, 1.84]
Overtime Willingness	4.93	5.26	1.25	4.43	1.50	+0.83	[0.17, 1.49]
Comfortable to Work With	4.73	5.12	1.15	4.14	1.24	+0.98	[0.40, 1.56]
Work Independently	4.69	5.14	1.24	4.00	1.44	+1.14	[0.49, 1.79]
Maternity Leave Bias	4.67	5.07	1.35	4.07	1.46	+1.00	[0.32, 1.68]
Site/Client Socializing	4.64	4.81	1.33	4.39	1.57	+0.42	[-0.28, 1.12]
Task Performance	4.54	4.93	1.20	3.96	1.43	+0.96	[0.33, 1.60]
Less Sick Leave Taken	4.46	4.86	1.22	3.86	1.43	+1.00	[0.36, 1.64]
Solve Problems Independently	4.46	4.90	1.32	3.79	1.66	+1.12	[0.39, 1.84]
Resignation Risk Post-Marriage/Birth	4.43	4.93	1.37	3.68	1.61	+1.25	[0.52, 1.98]
Peer Socializing	4.40	4.67	1.24	4.00	1.39	+0.67	[0.03, 1.30]
Computer/Software Proficiency	4.31	4.40	1.33	4.18	1.54	+0.23	[-0.46, 0.92]
Productivity & Competitiveness	4.11	4.55	1.02	3.46	1.23	+1.08	[0.53, 1.64]
Carry Out Responsibilities	4.09	4.50	1.38	3.46	1.55	+1.04	[0.33, 1.75]

Table 3B: Descriptive Statistics, *t*-Tests, Effect Sizes, and 95% Confidence Intervals for Perceived Gender Competencies (*N* = 70) (continued)

Survey Item / Dimension	<i>t</i> -statistic	<i>p</i> -value	Cohen's <i>d</i>	Interpretation
Physical Strength	2.99	0.0038**	0.73	Moderate male favourability
Control Emotions	2.09	0.0402*	0.51	Moderate male favourability
Mentally Stronger	2.93	0.0046**	0.71	Moderate male favourability
Overtime Willingness	2.50	0.0149*	0.61	Moderate male favourability
Comfortable to Work With	3.37	0.0012**	0.82	Large male favourability
Work Independently	3.48	0.0009***	0.85	Large male favourability
Maternity Leave Bias	2.93	0.0045**	0.72	Moderate male favourability
Site/Client Socializing	1.19	0.2400	0.29	Statistically Insignificant
Task Performance	3.03	0.0035**	0.74	Moderate male favourability
Less Sick Leave Taken	3.10	0.0028**	0.76	Moderate male favourability

Solve Problems Independently	3.06	0.0031**	0.75	Moderate male favourability
Resignation Risk Post-Marriage/Birth	3.44	0.0010***	0.84	Largest In-Group Divergence
Peer Socializing	2.08	0.0413*	0.51	Moderate male favourability
Computer/ Software Proficiency	0.66	0.5147	0.16	Gender Parity
Productivity & Competitiveness	3.92	0.0002***	0.96	Large male favourability
Carry Out Responsibilities	2.90	0.0049**	0.71	Moderate male favourability

* $p < 0.05$, $p < 0.01$, *** $p < 0.001$

The statistical analysis reveals three primary patterns:

1. Shared Physical and Environmental Stereotypes: Both men and women rated physical strength high ($\mu = 5.74$), confirming an industry-wide perception that men hold a physical advantage for heavy site duties.
2. Technical Parity: Computer and engineering software usage yielded an overall mean near neutrality ($\mu = 4.31$) with no significant difference between men and women ($t = 0.66, p = 0.5147, d = 0.16$). Technical competency is evaluated as gender-neutral.
3. Statistically Significant In-Group Polarization: On 14 out of 16 items, male respondents exhibited significantly stronger endorsement of male superiority than female respondents ($p < 0.05$). The largest perception gap occurred regarding resignation risk post-marriage/giving birth ($\Delta = +1.25, t = 3.44, p = 0.0010, d = 0.84$), where men viewed family commitments as a female turnover risk ($\mu_{\text{Male}} = 4.93$), whereas women rejected this characterization ($\mu_{\text{Female}} = 3.68$).

To evaluate how these perceptions affect recruitment, respondents selected between a male and female candidate with identical qualifications. Out of 58 valid responses:

- 50.0% ($n = 29$) explicitly preferred the male candidate.
- 41.4% ($n = 24$) based their decision on position context, CGPA, or merit.
- 8.6% ($n = 5$) explicitly preferred the female candidate.

The empirical findings illustrate how Social Role Theory and Role Congruity Theory operate within technical engineering environments. While technical skills are acknowledged as equitable, systemic bias continues to influence hiring preferences and task allocation.

A key qualitative finding is the structural division of labour into field/site roles and consultant/office roles. Male candidates are systematically favoured for site supervision, contractor interaction, and outstation work due to perceived advantages in physical endurance, overtime flexibility, and safety management. Conversely, female engineers are frequently redirected toward design, planning, authority compliance, and office management. Qualitative comments emphasize that female engineers are viewed as “*more detailed at work.*”, “*thorough.*” and possessing higher academic marks (CGPA). While this recognition highlights technical competence, it reinforces occupational segregation by restricting female access to critical field leadership experience required for executive promotion.

The starkest divergence between male and female respondents lies in perceptions of turnover risk, maternity leave, and working hours. Male managers often engage in statistical discrimination, assuming female engineers will resign or reduce commitment following marriage or childbirth. However, female respondents challenge this narrative, asserting that structural barriers—such as rigid working hours, uncompensated overtime, and lack of site amenities—rather than a lack of professional ambition, drive career friction. This gap demonstrates how traditional organizational expectations penalize female practitioners.

Despite persistent gender biases, most respondents advocated for gender-neutral hiring based strictly on skills, CGPA, and interview performance. Progressive feedback indicates an increasing recognition within the industry that diverse engineering teams enhance both problem-solving capabilities and operational efficiency.

CONCLUSIONS

This study provides empirical insights into the persistence of gender-based perceptions, structural stereotypes, and recruitment biases within the engineering sector. Utilizing a mixed-methods approach, the research systematically evaluated perceived technical, operational, physical, and socio-emotional competencies between male and female engineers.

The empirical findings yield three primary conclusions. First, the data reveal a perceptual convergence on technical parity, with software proficiency and computer tool usage evaluated as gender-neutral, demonstrating that core technical competence in modern engineering is broadly recognized regardless of gender. Second, a pronounced occupational and spatial segregation persists regarding site work, physical strength, and overtime willingness. This manifests as a structural "Site vs. Office" dichotomy, where male engineers are systematically favoured for field operations and outstation assignments—evidenced by a strong male preference in hypothetical hiring scenarios—while female engineers are disproportionately steered toward office-bound design, documentation, and compliance roles. Third, statistically significant in-group perception divergences and statistical discrimination were observed across a majority of competency items, with male respondents demonstrating substantially higher male-favourable bias than female respondents. The widest perceptual gap centred on turnover risk following marriage or childbirth, indicating that male managerial choices remain heavily influenced by statistical discrimination regarding family commitments—a premise that female practitioners explicitly reject. Nevertheless, the overwhelming majority of respondents advocated for gender-neutral, merit-based hiring based strictly on technical capability and performance, signalling a growing industry transition toward competence-driven recruitment that provides a strong foundation for institutional policy interventions.

To dismantle structural biases and foster equitable career progression in engineering organizations, several targeted strategies are recommended. First, engineering firms should implement blind and structured recruitment frameworks. Human resource departments ought to adopt anonymized resume processing—stripping applicant names and gender markers—to mitigate implicit bias during initial shortlisting, while replacing subjective interview evaluations with standardized, competency-indexed rubrics focused strictly on technical capabilities, problem-solving skills, and academic performance.

Second, organizations must establish equitable field experience pipelines to ensure career growth parity. Engineering firms should institute mandatory early-career rotation programs that guarantee equal site and office exposure for all young engineers. Concurrently, contracting firms need to modernize site infrastructure, enforce rigorous safety protocols, and address off-hours security concerns so that physical site conditions no longer serve as structural bottlenecks to female field participation.

Finally, the industry must modernize its work culture and performance metrics by transitioning from presence-based hours to output-based evaluations. Prioritizing project delivery quality and operational efficiency over uncompensated overtime mitigates the structural penalty currently imposed on professionals with caregiving responsibilities. Complementing this, firms should establish structured post-maternity career continuity frameworks to ensure temporary family commitments do not permanently derail leadership advancement or field opportunities.

While this study offers valuable empirical contributions, certain methodological limitations present avenues for future investigation. First, because the sample represents a localized regional cross-section, future research should expand sample sizes across broader geographical regions and analyse distinct sub-disciplines—such as civil, mechanical, electrical, and structural engineering—to capture sectoral nuances. Second, because cross-sectional survey data capture only a single operational snapshot, longitudinal research tracking cohort career trajectories over multi-year periods is necessary to pinpoint the exact organizational inflection points where female engineer attrition or occupational diversion occurs.

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