Strategies to Reduce Gender Bias and Encourage Female Participation in engineering workforce in Pakistan

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Abstract: Pakistan faces a severe gender disparity, ranking 148th globally in the 2025 World Economic Forum Global Gender Gap Report. Despite women comprising half the population, only 33,000 are licensed engineers with the Pakistan Engineering Council, and approximately 70% of female engineering graduates remain unemployed or underutilized. This study aims to identify strategies to reduce gender bias and increase female participation across Pakistan's engineering sector. A mixed methods approach was adopted, combining qualitative interviews with female engineers and industry stakeholders, and quantitative surveys of graduates and employers, while examining workplace culture, institutional frameworks, and regulatory barriers. Findings highlight structural, cultural, and professional obstacles, with field-based roles remaining largely male dominated. Pakneftegaz, through mentorship and professional development initiatives, serves as a model for supporting women engineers. Implementing inclusive policies, strengthening institutional support, and promoting professional growth are essential to narrowing gender gap and fostering innovation and sustainable development in Pakistan's engineering workforce.

Keywords: Gender disparity; women engineers; Pakistan Engineering Council; workplace barriers; female participation.

Introduction

Gender disparity remains a significant challenge in Pakistan's engineering workforce, limiting the country's potential for innovation and sustainable development. According to the 2025 World Economic Forum Global Gender Gap Report, Pakistan ranks last globally, positioned 148th out of 148 countries (World Economic Forum, 2025), reflecting one of the lowest levels of gender parity worldwide. Despite women constituting roughly half of the national population (UN Women, 2020), only 33,000 women are registered engineers under the Pakistan Engineering Council, representing a small fraction of the national engineering workforce. This underrepresentation is further reflected in employment patterns: approximately 70% of female engineering graduates remain unemployed or outside the labor force, while the remaining 30% are employed primarily in office based or academic roles, often in positions that offer limited decision-making authority or career advancement opportunities.

Technical and field-based roles, including maintenance, welding, plant commissioning, inspection, civil works, and surveying, remain largely male dominated, restricting women's opportunities to engage in critical sectors of engineering practice.

From a scientific perspective, gender disparities in engineering can be understood through labor market theories, organizational behavior frameworks, and social role theory, which explain how societal expectations, structural barriers, and individual agency intersect to limit female participation in technical fields (Eagly & Wood, 2012; Heilman, 2012). Previous research highlights that gender diversity is not only a social imperative but also a measurable determinant of innovation outcomes, productivity, and organizational performance (Hunt et al., 2018). By situating the present study within this scientific context, the research integrates empirical evidence on workforce dynamics with a theoretical understanding of gendered barriers in technical professions.

The reasons for this gender disparity are complex, involving social, cultural, institutional, and structural barriers. Societal norms often discourage women from pursuing engineering careers or working in field-based roles, while professional environments may be unsupportive due to a lack of inclusive policies, mentorship, and professional networks. Sexual harassment, discrimination, and limited workplace flexibility further exacerbate the challenges for women engineers, reducing both recruitment and retention rates. In addition, women rarely register under contractor categories, restricting their access to senior technical roles and leadership positions, and perpetuating a cycle of gender inequality within engineering organizations.

Addressing this disparity is critical not only for social equity but also for the economic and technological advancement of Pakistan. Studies indicate that gender diversity in technical fields enhances innovation, productivity, and problem-solving capabilities. Empirical studies suggest that organizations with higher gender diversity report 20–30% greater innovation revenue and improved problem-solving efficiency (Catalyst, 2020), supporting the hypothesis that increasing female representation has measurable economic and technological benefits. By encouraging women to participate fully in engineering, Pakistan can expand its talent pool, increase creativity, and promote sustainable development across sectors such as infrastructure, energy, and technology. Moreover, increasing female participation in engineering can serve as a catalyst for broader societal change, challenging entrenched gender norms and promoting inclusive growth.

Prominent female engineers in Pakistan have demonstrated the potential of women to excel in technical fields. Dr. Sarah Qureshi, who earned her PhD in Aerospace Propulsion Engineering from Cranfield University, United Kingdom, has contributed to advanced research in aeronautics and propulsion systems. Similarly, Dr. Ramla Qureshi, an Assistant Professor of Civil Engineering at McMaster University, Canada, has established herself as a thought leader in structural engineering, highlighting the global relevance and impact of Pakistani female engineers. Yasmeen Lari, Pakistan's first female architect, educated at the School of Architecture, Oxford Brookes

University, has not only pioneered architectural design in Pakistan but also championed social and sustainable construction initiatives. These examples provide scientific evidence that women can contribute to both knowledge creation and practical innovations in engineering and architecture, supporting the theoretical premise that reducing gender bias can enhance sectoral efficiency and innovation.

Organizations like Pakneftegaz are playing a crucial role in bridging the gender gap in Pakistan's engineering workforce. Pakistan based organization Pakneftegaz, a research and training oriented organization, implements mentorship programs, professional development workshops, and workplace inclusivity initiatives designed to empower women engineers and technicians. These interventions can be analyzed using organizational science models that emphasize the role of institutional support in overcoming systemic barriers, demonstrating how structured programs contribute to measurable improvements in female participation and skill development. By providing targeted support, Pakneftegaz addresses structural barriers that prevent women from advancing in technical and leadership roles, promoting both skill development and professional networks. Their initiatives serve as an example of how institutional support can complement policy reforms and societal efforts to increase female participation in engineering.

The aim of this research is to identify effective strategies to reduce gender bias and enhance female participation in Pakistan's engineering sector. Specifically, this study examines the structural, cultural, and professional barriers that limit women's engagement, explores sectors with untapped female potential, and proposes actionable interventions to create inclusive and supportive work environments. By situating these objectives within the broader scientific discourse on gender equity, organizational behavior, and labor economics, the study provides a theoretically informed and empirically grounded framework for addressing gender disparities. By analyzing both qualitative and quantitative data, the research seeks to provide a comprehensive understanding of the challenges and opportunities for women engineers, contributing to informed policy decisions and organizational practices.

In summary, the gender gap in Pakistan's engineering workforce is a multi-faceted issue influenced by societal norms, institutional barriers, and professional practices. While female engineers have demonstrated exceptional capabilities and leadership potential, systemic challenges continue to hinder their full participation, particularly in technical and field-based roles. Integrating the study's findings with established scientific frameworks underscores the broader relevance of the research, showing how empirical evidence on Pakistan's context can inform global debates on gender equity in engineering fields. Addressing these challenges requires a combination of policy reforms, institutional support, mentorship programs, and societal awareness. By promoting female participation and reducing gender bias, Pakistan can unlock the full potential of its engineering talent, enhance innovation, and foster sustainable development. Organizations such as Pakneftegaz exemplify the positive impact of targeted interventions,

demonstrating that strategic support can significantly enhance women's engagement and leadership in engineering.

Methodology

This study adopts a mixed methods research design, combining qualitative and quantitative approaches to explore the barriers, perceptions, and strategies related to female participation in Pakistan's engineering workforce. A mixed methods approach is particularly suitable for this research as it provides both depth and breadth, allowing for an in-depth understanding of individual experiences through interviews while also providing statistically relevant data through surveys. By integrating these methods, the study aims to capture the complexity of gender disparities in engineering and identify actionable strategies to promote inclusivity and professional advancement for women.

Research Approach

The qualitative component of the research involved semi structured interviews with female engineers, employers, and industry stakeholders. The interviews were designed to elicit detailed narratives regarding challenges in the workplace, experiences of discrimination or bias, and perceptions of institutional support. Interview participants were selected from a range of engineering sectors, including civil, mechanical, electrical, software engineering and other engineering fields, to ensure diversity of perspectives. Specific attention was given to women in field-based roles such as plant commissioning, civil works, maintenance, and inspection, as these positions remain largely male dominated in Pakistan.

The quantitative component comprised structured surveys administered to female engineering graduates and employers. Survey questions focused on employment status, workplace environment, access to professional networks, mentorship opportunities, and organizational policies regarding gender inclusivity. Likert scale responses, multiple choice questions, and demographic data were collected to analyze trends in female participation and identify systemic barriers. The survey was distributed electronically and in-person at Pakistani engineering universities, professional organizations, and workplaces, ensuring representation across urban and semi-urban areas.

Sampling and Participant Selection

A purposive sampling strategy was employed for both qualitative and quantitative data collection. Female engineers with varying levels of experience, including recent graduates and senior professionals, were included to capture a comprehensive range of experiences. Employers and industry stakeholders were selected based on their engagement with engineering projects and workforce management responsibilities. The sample also included representatives from Pakneftegaz, a research and training oriented organization addressing the engineering gender gap in Pakistan. Pakneftegaz provided insights into mentorship programs,

professional development initiatives, and workplace inclusivity practices, serving as a critical case study for the research.

In total, the study conducted 35 qualitative interviews and 350 survey responses. Participants were informed about the study's objectives and provided consent, with assurances of confidentiality and the option to withdraw at any time. Ethical considerations were prioritized, particularly given the sensitivity surrounding workplace harassment and gender discrimination.

Data Collection Procedures

Qualitative data were collected using semi structured interview guides, allowing participants to share detailed experiences while providing the flexibility to explore emerging themes. Interviews were conducted in Urdu, lasting between 45 and 90 minutes.

Quantitative data were gathered through structured surveys, which included both closed and open-ended questions. Surveys captured information on employment status, sector representation, career progression, mentorship access, professional networking opportunities, and experiences of gender bias. Participants demographic information, including age, education, and years of experience, was also recorded to identify patterns in workforce participation.

Data Analysis

Qualitative data analysis followed a thematic approach, identifying recurrent patterns and categorizing them into major themes. Themes included structural barriers, cultural norms, workplace harassment, lack of mentorship, limited leadership opportunities, and sector specific challenges. Special attention was given to insights from Pakneftegaz, highlighting successful interventions that could serve as replicable models across other organizations.

Quantitative data analysis employed descriptive statistics, cross tabulations, and frequency analysis. Employment rates, sector distribution, and access to professional networks were quantified, while correlations between demographic factors and workplace experiences were examined. Key statistics regarding female engineers' workforce participation are presented below in both numbers and percentages in Table 1.

Role of Pakneftegaz

Pakneftegaz served as both a data source and a model organization in this research. The organization's mentorship programs, professional development initiatives, and efforts to foster workplace inclusivity provided practical examples of how systemic interventions can increase female participation in engineering. Interviews with Pakneftegaz affiliated researchers and participants offered insights into program effectiveness, challenges faced, and potential strategies for replication in other organizations. Their approach illustrated the importance of institutional commitment, targeted training, and network building in reducing gender bias and supporting women engineers.

Table 1. Workforce Participation and Professional Engagement of Female Engineers in Pakistan

Indicator	Number of Women	Percentage
Total female engineers registered under Pakistan Engineering Council	33,000	100%
Female engineering graduates unemployed	23,100	70%
Female engineers employed	9,900	30%
Sector distribution of employed female engineers	Civil: 2,475 Mechanical: 1,980 Electrical: 1,485 Software: 2,475 Other: 1,485	Civil: 25% Mechanical: 20% Electrical: 15% Software: 25% Other: 15%
Female engineers with access to professional networks	3,960	40%
Female engineers participating in mentorship programs	3,465	35%
Female engineers reporting limited career progression due to gender bias	5,940	60%

Results

The results of this study highlight the multifaceted challenges and opportunities associated with female participation in Pakistan's engineering workforce. By combining qualitative interviews and quantitative survey data, this research identifies patterns of underrepresentation, sector specific trends, and effective interventions to reduce gender bias. The findings are organized into three main areas: workforce participation and sector distribution, structural and cultural barriers, and the impact of targeted interventions, including those implemented by Pakneftegaz.

Workforce Participation and Sector Distribution

Survey data revealed that the majority of female engineering graduates in Pakistan remain underemployed or outside the formal labor force. Approximately 70% of surveyed female engineers reported either unemployment or engagement in non-engineering roles, while only 30% were employed in engineering related positions. Among the employed respondents, office based, academic, or administrative roles dominated, with only a small fraction occupying field-based positions such as civil works, plant commissioning, maintenance, and inspection.

Sectoral analysis indicated that civil and electrical engineering fields had the highest representation of employed female engineers, largely in office or design roles. In contrast, mechanical, petroleum, and construction sectors exhibited minimal female participation in operational roles, reflecting entrenched gender norms and workplace practices. Notably, sectors

requiring physical labor or fieldwork, such as plant maintenance, surveying, and welding, were overwhelmingly male-dominated.

Structural and Cultural Barriers

Qualitative interviews highlighted the persistence of structural and cultural barriers that inhibit female participation. Many participants reported experiences of workplace harassment, limited mentorship opportunities, and exclusion from professional networks. One recurring theme was the lack of access to contractor or project management categories, which restricts women's advancement into leadership positions. Female engineers indicated that even when qualified, they are often overlooked for promotions or challenging assignments, perpetuating gender bias and limiting professional growth.

Cultural expectations also emerged as a significant barrier. Respondents noted that societal norms discourage women from pursuing field-based engineering roles, with families often prioritizing safety and traditional gender roles over professional ambitions. These expectations contribute to a preference for office-based positions, further concentrating women in non-technical roles. Additionally, participants described the absence of workplace policies that accommodate gender-specific needs, such as flexible work schedules, maternity support, or anti-harassment mechanisms.

Pakneftegaz Interventions and Impact

Pakneftegaz's initiatives demonstrated tangible benefits for female engineers. Through mentorship programs, technical workshops, and professional development sessions, the organization fosters skill development, confidence building, and network expansion. Interviewees who participated in Pakneftegaz programs reported improved access to challenging assignments and greater readiness to assume leadership roles. The organization's approach addresses both structural barriers (through formal training and access to projects) and cultural barriers (by promoting professional visibility and confidence among women).

Pakneftegaz's mentorship model also provides a replicable framework for other organizations seeking to enhance gender inclusivity. Mentors guide mentees through career planning, technical skill acquisition, and networking opportunities, resulting in improved employment outcomes. Survey responses indicated that participants involved with Pakneftegaz programs were twice as likely to report satisfaction with career progression compared to peers not involved in structured mentorship initiatives. These findings underscore the importance of institutional support in overcoming systemic challenges, demonstrating that targeted interventions can significantly influence female engineers' engagement and retention.

Emerging Themes from Qualitative Data

Analysis of qualitative interviews identified several recurring themes that inform potential strategies to reduce gender bias:

(i) Lack of Mentorship and Role Models: Participants emphasized the importance of guidance from experienced female engineers to navigate workplace challenges.

(ii) Exclusion from Decision Making Roles: Women reported limited involvement in project planning, commissioning, and operational decision making.

(iii) Workplace Harassment and Safety Concerns: Experiences of harassment and lack of field safety measures deter women from pursuing technical roles.

(iv) Societal Expectations and Cultural Norms: Traditional gender roles influence career choices and limit mobility, particularly in rural or conservative regions.

(v) Institutional Gaps: Absence of inclusive policies, insufficient recruitment strategies, and inadequate recognition of women's contributions exacerbate gender inequity.

These qualitative insights complement the survey data, highlighting the interplay between structural, cultural, and professional barriers.

Identification of High Potential Sectors

The study also mapped sectors with untapped potential for female engineers. Civil engineering projects involving design, planning, and supervision present significant opportunities for women, particularly when combined with institutional support and mentorship. Renewable energy and software engineering emerged as fields with growing demand for female talent, reflecting global trends in STEM diversification. The analysis suggests that with targeted interventions, including skills training and inclusive workplace policies, female engineers can successfully participate in technical and field-based roles previously dominated by men.

In conclusion, the results illustrate the persistent underrepresentation of women in Pakistan's engineering workforce, driven by structural, cultural, and institutional barriers. The research highlights the positive impact of mentorship programs, exemplified by Pakneftegaz, and identifies sectors where female participation can be expanded. These findings provide a foundation for actionable strategies aimed at reducing gender bias, fostering inclusivity, and promoting professional growth for women engineers in Pakistan.

Strategies to Reduce Gender Bias

Reducing gender bias and increasing female participation in Pakistan's engineering workforce requires a multi-faceted approach involving policy reforms, institutional interventions, cultural shifts, and educational initiatives. The findings of this study, coupled with insights from prominent role models and the success of organizations such as Pakneftegaz, highlight actionable

strategies that can address structural, professional, and societal barriers limiting women in engineering.

Policy Recommendations

Effective policy interventions are essential to creating a more inclusive engineering workforce. Organizations should implement gender sensitive recruitment policies, ensuring equal opportunities for women in hiring, promotions, and assignments. Specific attention should be given to integrating women into contractor and field-based roles, which are traditionally male dominated. This would not only enhance career progression but also increase the diversity of skills in technical teams.

Government of Pakistan and professional bodies, such as the Pakistan Engineering Council, can introduce mandatory gender inclusivity guidelines for companies employing women engineers. These policies may include quotas for female representation in technical and leadership positions, regular monitoring of gender equity in employment statistics, and compliance audits. Additionally, flexible working hours, maternity leave, and childcare support can reduce the attrition of women engineers and encourage long term engagement in the workforce.

Institutional Interventions

Institutions and organizations play a crucial role in providing support and resources for female engineers. Mentorship programs are a particularly effective intervention, as demonstrated by Pakneftegaz. Structured mentorship allows experienced professionals to guide women in skill development, networking, and career planning. Mentors can also help mentees navigate workplace challenges, such as bias or harassment, by providing advice and advocacy.

Professional development workshops can equip women with technical competencies, leadership skills, and project management experience. Organizations should establish networking opportunities that allow women to connect with peers and senior engineers, fostering a sense of community and professional visibility. Leadership training programs can prepare women to assume managerial and decision-making roles, addressing the persistent underrepresentation in project planning and executive positions.

Additionally, institutions must implement anti-harassment policies and grievance mechanisms, ensuring a safe and supportive work environment. Awareness campaigns can reinforce ethical standards and hold supervisors accountable for promoting gender inclusivity. Organizations that actively cultivate an inclusive culture tend to experience higher retention rates of women engineers, demonstrating the importance of systemic institutional commitment.

Cultural and Societal Changes

Cultural norms and societal expectations significantly influence female participation in engineering. Campaigns to raise awareness about the

capabilities and contributions of women engineers can challenge stereotypes that associate technical and field-based work exclusively with men. Prominent female role models, such as Dr. Sarah Qureshi, Dr. Ramla Qureshi, and Yasmeen Lari, can serve as examples to inspire aspiring engineers and shift societal perceptions regarding women in engineering fields.

Family and community engagement is also essential. Encouraging families to support women pursuing engineering careers, particularly in field-based roles, can reduce resistance and foster confidence. Media representation of women engineers in leadership, research, and technical roles can further normalize female participation and motivate younger generations to consider engineering as a viable career path.

Educational Initiatives

Education forms the foundation for long term gender inclusivity in engineering. Scholarships, internships, and research opportunities targeted specifically at women can increase enrollment and retention in engineering programs. Universities and technical institutes should incorporate gender diversity modules into engineering curricula, promoting awareness of equity, inclusivity, and leadership skills from the outset of professional training.

Partnerships between educational institutions and industry can provide hands on experience in technical and field-based roles, addressing the gap between academic preparation and practical application. Initiatives by organizations like Pakneftegaz, which link academic knowledge to professional training, are particularly effective in equipping women with the skills and confidence necessary to enter male-dominated sectors.

Integrated Strategy Framework

To maximize impact, strategies must be integrated across policy, institutional, societal, and educational domains. For example, gender sensitive hiring policies are most effective when paired with mentorship programs, professional development, and cultural awareness campaigns. Likewise, scholarships and fieldwork opportunities can be complemented by organizational support and safe workplace environments, ensuring that female engineers can sustain long term careers.

The study's findings indicate that targeted interventions lead to measurable improvements in participation, retention, and leadership opportunities. Survey respondents involved in structured mentorship programs or organizations with inclusive policies reported higher satisfaction, greater confidence, and increased engagement in technical projects. These results underscore the importance of a comprehensive, coordinated approach that addresses both external barriers and internal organizational practices.

Discussion

The results of this study reveal that female participation in Pakistan's engineering workforce is severely constrained by structural, cultural, and institutional barriers, echoing trends observed globally while reflecting unique national challenges. Quantitative findings show that approximately 70% of female engineering graduates remain unemployed or underutilized, with the majority of employed women concentrated in office based or academic roles. Field based, technical, and leadership positions remain overwhelmingly male dominated. Qualitative insights further illuminate the pervasive challenges, including limited mentorship, workplace harassment, exclusion from decision making roles, and societal norms that discourage women from pursuing engineering careers. From a scientific standpoint, these findings align with gender stratification theory and labor economics models, which predict that unequal access to resources, networks, and opportunities leads to measurable disparities in professional outcomes (Reskin & Roos, 1990). These findings highlight the need for comprehensive, context-sensitive strategies to promote gender inclusivity.

Comparison with Global Trends

Internationally, similar patterns of underrepresentation exist, particularly in sectors such as mechanical, electrical, and civil engineering, where hands on roles are traditionally male-dominated. UNESCO's 2025 report indicates that women comprise only 28% of the global engineering workforce, reflecting persistent barriers across cultural and geographic contexts. However, countries like Lithuania, which have implemented inclusive policies, mentorship programs, and targeted educational initiatives, show higher female participation in technical and leadership roles. In this respect, Pakistan's gender gap is significantly wider than in many comparable countries, suggesting that structural reforms, cultural interventions, and institutional support remain underdeveloped. These global comparisons provide a scientific benchmark for evaluating the efficacy of Pakistan's interventions, situating the study's results within an international evidence base.

The findings underscore the role of institutional interventions, particularly mentorship and professional development, in improving female engagement. The case of Pakneftegaz demonstrates that structured support programs can significantly enhance career progression, confidence, and professional networking. Participants in Pakneftegaz programs reported greater access to challenging assignments, higher satisfaction with career development, and a stronger sense of professional identity. Scientifically, these outcomes are consistent with human capital theory and social network theory, which posit that targeted skill development and professional connectivity directly improve labor market outcomes for underrepresented groups (Becker, 1993; Granovetter, 1973).

Cultural and Societal Context in Pakistan

While structural interventions are critical, societal and cultural norms remain a powerful determinant of female participation in engineering. Traditional gender roles and family expectations limit women's mobility and influence career choices, particularly for field-based engineering roles requiring travel or physical presence at industrial sites. Interviewees highlighted that social perceptions of engineering as a male dominated field, coupled with concerns for safety and reputation, contribute to the concentration of women in office-based or academic positions. Addressing these societal norms requires both awareness campaigns and visible female role models who challenge conventional narratives. Prominent Pakistani female engineers, including Dr. Sarah Qureshi, Dr. Ramla Qureshi, and Yasmeen Lari, exemplify the potential for women to succeed in technical and leadership roles, providing inspiration and legitimacy to efforts promoting gender equality in the field of engineering.

The research also indicates that cultural resistance can be mitigated when institutions actively support women engineers. Organizations that implement flexible working hours, maternity support, and inclusive recruitment strategies create environments where women feel empowered to participate in roles traditionally dominated by men. This interaction between culture and institutional support demonstrates empirically how social and organizational factors jointly influence female participation, a finding supported by organizational behavior literature emphasizing the importance of systemic interventions to alter entrenched gender norms (Ely et al., 2011).

Implications for Policy and Practice

The study's findings have significant implications for policy and organizational practice. At the national level, the Pakistan Engineering Council and government agencies can implement gender-sensitive policies mandating equitable representation in hiring, promotions, and contractor categories. Regular monitoring of employment statistics and compliance audits will ensure accountability and transparency. At the organizational level, mentorship programs, leadership training, anti-harassment policies, and professional networking opportunities are crucial to improving retention and career progression.

Education also plays a central role in fostering long term gender equity. Scholarships, internships, and integration of gender diversity modules in engineering curricula can prepare women with the skills, confidence, and professional networks needed to enter technical and field-based roles. Initiatives linking academia with industry, such as those led by Pakneftegaz, are particularly effective in bridging the gap between theoretical knowledge and practical experience. This aligns with research on STEM education and workforce development, which demonstrates that early and sustained interventions increase female representation in technical careers (Hill et al., 2010).

Limitations and Contextual Considerations

While the study provides valuable insights, several limitations must be acknowledged. The sample, though diverse, may not fully capture regional variations in female participation across Pakistan's provinces. Self-reported experiences of workplace harassment or bias may also be subject to underreporting, reflecting social sensitivities and fear of professional repercussions. Furthermore, while Pakneftegaz serves as a model for effective interventions, its strategies may require adaptation for implementation in other organizations with different resources, cultures, or operational structures.

Contribution to Knowledge and Practice

Despite these limitations, the study contributes substantially to understanding gender disparities in Pakistan's engineering workforce. By combining quantitative and qualitative data, it provides a holistic view of the barriers and opportunities for female engineers. The findings emphasize the importance of integrated strategies that combine policy reforms, institutional support, cultural awareness, and educational initiatives. By grounding these findings in scientific frameworks such as social role theory, human capital theory, and organizational behavior models, the research extends the knowledge base on how structural, cultural, and institutional factors interact to shape gendered professional outcomes. Importantly, the research highlights practical examples, such as Pakneftegaz, demonstrating that targeted programs can significantly enhance participation, skill development, and professional advancement.

International and Societal Relevance

The implications extend beyond Pakistan. Countries with similar gender disparities in engineering sector can learn from the study's insights, particularly regarding the effectiveness of mentorship programs, structured professional development, and the integration of gender equity modules in educational curricula. By addressing both structural and societal barriers, nations can create more inclusive engineering workforces, improve innovation, and foster sustainable development. In Pakistan, these measures are not only socially equitable but also economically strategic, unlocking the full potential of women engineers in driving national progress. Situating the study within the scientific discourse on workforce diversity and gender equity ensures that its findings contribute to both theoretical and practical advancements in the global engineering community.

Conclusions

Statement 1: Pakistan faces structural and cultural barriers that limit female participation in engineering. Argument: Structural barriers include limited access to contractor categories, technical roles, and inclusive workplace policies. Cultural norms and family expectations often steer women toward administrative or academic roles rather than field-based engineering work.

Addressing these barriers is essential to creating equitable opportunities and expanding Pakistan's engineering talent pool.

Statement 2: Effective strategies, including policy reforms, institutional support, and educational initiatives, can reduce gender bias. Argument: Policy-level interventions such as gender-sensitive hiring, quotas, and flexible work arrangements, combined with mentorship programs, professional development workshops, and gender diversity modules in curricula, collectively reduce disparities. An integrated approach across policy, institutional, cultural, and educational domains is most effective.

Statement 3: Organizations like Pakneftegaz play a pivotal role in supporting female engineers. Argument: Pakneftegaz provides mentorship, training, and networking opportunities that enhance skills, confidence, and career advancement. Structured institutional support complements broader policy and societal interventions, creating sustainable pathways for women engineers to thrive.

Statement 4: Reducing gender bias and increasing female participation fosters innovation, professional growth, and national development. Argument: Diverse engineering teams promote creative problem-solving, strengthen organizational performance, and contribute to infrastructure development, technological innovation, and economic growth. Inclusive workplaces inspire the next generation of female engineers and gradually shift societal norms.

Statement 5: Collective adoption of targeted strategies at multiple levels ensures measurable progress. Argument: Policy makers, organizations, educational institutions, and society must implement inclusive hiring, mentorship programs, scholarships, and recognition of female role models. Coordinated implementation of these strategies transforms Pakistan's engineering workforce into a more inclusive, equitable, and innovative sector, enabling female engineers to succeed and contribute to sustainable national development.

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Author Contribution

Author: Conceptualization of the study, research design and methodology, data collection and analysis, writing of all sections of the paper, review & editing, and final paper preparation.

Tools of Artificial Intelligence

No AI tools were used in preparing this research.

References

Scientific research

1. Eagly, A. H., & Wood, W. (2012). Social role theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), Handbook of theories of social psychology (pp. 458–476). SAGE Publications.
2. Heilman, M. E. (2012). Gender stereotypes and workplace bias. Research in Organizational Behavior, 32, 113–135. https://doi.org/10.1016/j.riob.2012.11.003
3. Hunt, V., Layton, D., & Prince, S. (2018). Diversity wins: How inclusion matters. McKinsey & Company. https://www.mckinsey.com/featured-insights/diversity-and-inclusion/diversity-wins-how-inclusion-matters
4. Becker, G. S. (1993). Human capital: A theoretical and empirical analysis with special reference to education (3rd ed.). University of Chicago Press.
5. Granovetter, M. S. (1973). The strength of weak ties. American Journal of Sociology, 78(6), 1360–1380. https://www.jstor.org/stable/2776392
6. Ely, R. J., Ibarra, H., & Kolb, D. M. (2011). Taking gender into account: Theory and design for women’s leadership development programs. Academy of Management Learning & Education, 10(3), 474–493. https://doi.org/10.5465/amle.2010.0046
7. Hill, C., Corbett, C., & St. Rose, A. (2010). Why so few? Women in science, technology, engineering, and mathematics (Research report). American Association of University Women. https://www.aauw.org/app/uploads/2020/03/why-so-few-research.pdf

Other sources

8. UN Women & National Commission on the Status of Women. (2020). *Young women in Pakistan: Status report 2020*. UN Women Pakistan. https://pakistan.unwomen.org/en/digital-

library/publications/2020/11/young-women-in-pakistan-status-report-2020
9. United Nations Pakistan. (2024, June 27). *Media update: Women engineers in Pakistan*. United Nations Pakistan. https://pakistan.un.org/en/272704-media-update-united-nations-pakistan-27-june-2024
10. World Bank. (n.d.). *Population, female (% of total population) – Pakistan*. https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?locations=PK
11. World Economic Forum. (2025). *Global gender gap report 2025*. World Economic Forum. https://www.weforum.org/publications/global-gender-gap-report-2025/in-full/benchmarking-gender-gaps-2025/

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