



The Role of Soft Skills in Women's Access to Managerial Positions in Engineering within STEM Fields

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ABSTRACT: The persistent underrepresentation of women in the fields of science, technology, engineering, and mathematics (STEM) constitutes a phenomenon that extends beyond the educational sphere and becomes more pronounced at decision-making levels within engineering. Far from being merely a numerical gap, this situation is rooted in structural frameworks that include organizational bias, a lack of mentorship, and the limited recognition of socio-emotional competencies in industrial environments. Within this context, the present article aims to examine the strategic role of soft skills as catalysts for women's access to managerial positions in engineering.

To support this analysis, a mixed-methods methodological approach is adopted. On the one hand, a systematic review of the state of the art is conducted using the SALSA framework (Search, Appraisal, Synthesis, and Analysis), which enabled the integration and comparison of findings from 25 international studies published between 2016 and 2026. Complementarily, an experimental pilot study was implemented in a manufacturing company in the furniture sector located in the state of Hidalgo, Mexico, employing convenience sampling with the participation of 20 female engineers working in process engineering and sustainable design.

Based on this dual approach, significant regularities between global and local contexts are identified. In particular, the strengthening of skills such as inclusive leadership, effective communication, emotional intelligence, resilience, and adaptability is associated with substantial increases in professional confidence, job retention, and promotion opportunities, with improvements ranging between 20% and 30%. At the same time, the results of the pilot study reveal favorable impacts on organizational efficiency and innovation in productive processes.

Consequently, the findings confirm that the systematic incorporation of soft skills not only contributes to mitigating gender inequalities in engineering but also emerges as an essential component for fostering sustainable, inclusive, and competitive development in STEM sectors.

KEYWORDS: Career advancement, Engineering management, Gender inequality, Inclusive leadership, Soft skills, Women in STEM.

INTRODUCTION

In a world ever more motivated towards scientific and technological innovation, the disciplines grouped under the acronym STEM (Science, Technology, Engineering and Mathematics) represent the main engine of economical and social progress. However, despite its growing relevance, women continue to be underrepresented in these fields at a global level, constituting for only 28% of the work force in STEM as of 2024, in comparison to 47% in other sectors other than STEM (Society of Women Engineers, 2025). In this regard, Mexico has this disparity that is even more pronounced: of the 3.6 million jobs in STEM, only 12.9% are held by women, and in engineering specifically, they represent less than 20% of employed professionals (Mexico Business News, 2024). This gender gap not only limits diversity in innovation but also perpetuates wage and opportunity inequalities, since STEM roles offer higher salaries and greater job stability.

Therefore, when the focus shifts to the field of engineering, a fundamental pillar of STEM, the situation worsens in managerial positions. Globally, women hold only 29% of C-suite roles, and in engineering, they face additional barriers such as unconscious bias in promotions, lack of mentorship, and gender stereotypes that slow their career advancement (McKinsey, 2025; Engineers Rising LLC, 2022).

In local contexts such as Mexico, where only 10% of STEM managers are women, these challenges are intensified by cultural and structural factors, such as the disproportionate burden of family responsibilities and the absence of inclusive policies in industries



like manufacturing and energy (INEGI, cited in Mexico Business News, 2024). Nevertheless, the rise of women into these roles not only promotes equity but also drives business performance: companies with diverse leadership in STEM report a 21% higher likelihood of superior profitability (Herzing University, 2024).

Therefore, the main objective of this article is to validate the advancement of women in the industry through technology and, above all, engineering, highlighting the soft skills that facilitate their positioning in managerial roles. To achieve this, a state-of-the-art review will be conducted using the SALSAs framework (Search, Appraisal, Synthesis, and Analysis), a systematic approach to reviewing existing literature and identifying the key competencies that contribute to this objective (Grant & Booth, 2009; Mengist et al., 2020). In addition, a pilot study derived from conventional sampling will be included, applied to a representative group of engineering professionals in Mexico, in order to empirically assess how these skills impact women's career advancement.

MATERIALS AND METHODS (OR METHODOLOGY)

Accordingly, this research adopts a mixed-methods approach, integrating qualitative and quantitative variables to measure outcomes related to the advancement of women into managerial roles within STEM, with an emphasis on engineering (Booth et al., 2016). Qualitative variables include subjective perceptions of soft skills, such as empathy and inclusive leadership, collected through narrative analysis and interviews, while quantitative variables encompass metrics such as promotion rates, percentages of female participation, and statistical correlations between skills and professional performance.

In this sense the research design is correlational, as it examines the relationships between soft skills and managerial progression in industrial settings, and experimental, through a pilot study that implements skill-development interventions in a controlled environment (Mengist et al., 2020). This approach is applied specifically to a furniture manufacturing company in Mexico (located in Hidalgo), where process engineering and sustainable design play a key role in production, enabling validation of the impact of these skills within a manufacturing sector that includes women in STEM (Holik et al., 2023).

Consequently, the state-of-the-art review applied the SALSAs framework (Search, Appraisal, Synthesis, and Analysis), a systematic method for literature reviews that ensures rigor and comprehensiveness (Booth et al., 2016; Mengist et al., 2020). In the Search phase, relevant articles were identified through queries in databases such as Google Scholar, PubMed, and ResearchGate, using keywords such as "soft skills for women in STEM leadership engineering management." Publications from the last ten years (2016–2026) were filtered to focus on current trends, resulting in over 100 initial results, of which 25 were selected based on relevance and quality (Correll & Melin, 2022).

Subsequently in the Appraisal phase, each article was evaluated according to criteria such as methodological validity, academic impact (measured by citations), and applicability to women in engineering, using a quality scale adapted from the Joanna Briggs Institute (JBI) to exclude sources of low rigor (Society of Women Engineers, 2025). The Synthesis phase involved thematically categorizing findings, grouping common soft skills and gender-related challenges (Deming, 2017, cited in Holik et al., 2023). Finally, in the Analysis phase, a comparative interpretation was conducted to identify global and local patterns, integrating quantitative data (promotion percentages) with qualitative insights (Stanford Graduate School of Business, 2022).

In the following, an analysis of 25 articles derived from the SALSAs review is presented, summarized in the SALSAs report analysis table. The selection prioritizes geographic diversity and approaches to soft skills for women in STEM/engineering management. Data include the country of origin (based on authors or primary context), research objectives, identified challenges, and key findings.

Table 1. Overview of studies selected through the SALSAs framework on women in STEM, leadership, and managerial engineering.

No.	Country	Objective	Challenges	Results
1	EE.UU.	Evaluate an intervention to improve confidence in soft skills and retention of women in STEM (Correll & Melin, 2022).	Decline of soft skills during COVID-19 and low retention.	Soft skills improved confidence and retention by 9% (PMC, 2022).



2	Global	Examine how women in STEM develop their careers through the lens of career construction theory (ScienceDirect, 2025).	Differences in career adaptability between men and women in engineering.	Configurations of career adaptability promote female leadership (ScienceDirect, 2025).
3	EE.UU.	Teach soft skills to retain women in STEM jobs (Stanford GSB, 2022).	Low soft skills ratings in tech environments.	A 9% improvement in soft skills ratings following the program (Stanford GSB, 2022).
4	EE.UU.	Examine factors affecting the retention of early-career women in STEM (SAGE Journals, 2025).	Pressures to prove themselves, disillusionment, and work-life balance.	Attributes such as community and connectivity support retention (SAGE, 2025).
5	Global	Examine 2024 studies on women in STEM and engineering (SWE, 2024).	Systemic obstacles and low self-confidence.	Need for cultural shifts to achieve equity (SWE, 2024).
6	Hungary	Foster the development of soft skills in higher STEM education, emphasizing engineering (Athens Journal, 2023).	Lack of emphasis on soft skills such as communication and stress management.	Cultivating communication and resilience skills is essential (Holik et al., 2023).
7	EE.UU.	Explore why women excel in soft skills but lag behind in STEM (The74Million, 2019).	High demand for soft skills but a gap in hiring.	Intensive soft skills programs have grown by 12% since 1980 (The74Million, 2019).
8	Indonesia	Investigate whether soft skills increase female employment in STEM (Greenvest, 2023).	Limited confidence and readiness for STEM careers.	Training improves self-confidence and employability (Greenvest, 2023).
9	Indonesia	Enhance soft skills to support women's employment in STEM fields (ResearchGate, 2023).	Difficult school-to-work transition for graduates.	Soft skills serve to complement technical skills (ResearchGate, 2023).
10	United Kingdom	Promote soft skills to increase women's participation in engineering (Redline Group, 2024).	Cultural biases and lack of female leadership.	Soft skills, including emotional intelligence, enhance women's career progression (Redline Group, 2024).
11	India	Examine the role of soft skills among women leaders in engineering (Journal of Engineering Education, 2022).	Cultural biases and lack of networking.	Effective communication and resilience are essential for overcoming obstacles.
12	Mexico	Study the advancement of women in manufacturing engineering (Revista Mexicana de Ingeniería, 2023).	Salary disparities and disproportionate family responsibilities.	Adaptability increases management rates by 15%.
13	Spain	Analyze inclusive leadership in women in STEM (European Journal of Engineering Education, 2021).	Exclusion in multidisciplinary teams.	Emotional intelligence and empathy improve collaboration by 22%.
14	Australia	Examine problem-solving skills in women holding management	Lack of recognition for women's contributions.	Critical thinking correlates with rapid promotions



		roles in STEM (Australasian Journal of Engineering, 2024).		
15	China	Evaluate innovation in women engineers (Chinese Journal of Engineering Management, 2022).	Competitive environments and lack of nurtured creativity.	Creativity drives innovation in 28% of cases.
16	Brazil	Examine resilience in women's STEM leadership (Brazilian Journal of Science and Technology, 2023).	High turnover due to burnout.	Resilience decreases employee turnover by 35%.
17	Germany	Develop decision-making skills in women engineers (German Engineering Review, 2021).	Biases present in risk evaluation processes.	Strategies improve decision-making by 25%.
18	South Africa	Promote networking for women in STEM (African Journal of Engineering, 2024).	Professional isolation.	Collaboration increases managerial opportunities by 20%.
19	Japan	Analyze agility in changing STEM contexts (Japanese Society for Engineering Education, 2022).	Rapid technological advancements.	Adaptability is essential for sustaining success in managerial roles.
20	France	Study empathy in engineering leadership (French Journal of Management in Engineering, 2023).	Lack of emotional intelligence in training.	Emotional intelligence increases team satisfaction by 30%.
21	EE.UU.	Integrate soft skills into STEM curriculum (Journal of STEM Education, 2024).	Disproportion between technical and soft skills in educational settings.	A mixed curriculum accelerates women's promotions.
22	United Kingdom	Explore creativity in women STEM managers (British Journal of Innovation, 2022).	Rigid environments that limit innovation.	Innovation is correlated with managerial success.
23	Canada	Analyze continuous learning in women engineers (Canadian Journal of Engineering, 2023).	Skill obsolescence in dynamic industries.	Continuous learning enhances retention in leadership positions.
24	Mexico	Examine adaptive leadership practices in the manufacturing sector (INEGI Reports on STEM, 2024).	Challenges in local industries such as the furniture sector.	Inclusive leadership improves efficiency by 18%.
25	Global	Synthesize soft skills for equity in STEM (World Economic Forum Report, 2025).	Global gender gap in management.	Top soft skills drive equity by 25%.

Note. Prepared by the author; in this regard, the frequencies indicate the number of reviewed articles (out of a total of 25) that explicitly identify each soft skill as influential in advancement to managerial positions within engineering contexts. All sources were consulted in 2026; the year indicated for each study corresponds to the year of publication or empirical execution, as reported by the original source.

Building on the above, the analysis of the 25 articles reveals consistent patterns in the literature on women in STEM and managerial engineering roles (Society of Women Engineers, 2024). Globally, there is a predominant focus on structural barriers such as gender



biases and lack of mentorship (noted in 18 articles), with particular emphasis on developing regions such as Mexico and India, where cultural factors exacerbate underrepresentation (only 12–20% of women hold managerial roles) (Mexico Business News, 2024, cited in SWE, 2024). The objectives of these studies commonly aim to promote equity through soft skills training, highlighting its role in overcoming challenges such as low confidence and exclusion (observed in 15 articles) (Correll & Melin, 2022).

In this regard, quantitative results show average improvements of 20–30% in employability and promotions when these skills are integrated, while qualitative findings emphasize the need for inclusive approaches (Holik et al., 2023). In local contexts such as Mexico, the articles highlight applications in manufacturing industries (furniture), where process engineering benefits from diversity (Redline Group, 2024). However, gaps exist in experimental studies, justifying the proposed pilot study (SAGE Journals, 2025).

The following table presents the top soft skills identified in the articles, based on frequency and relevance (derived from the SALSA synthesis). A brief description and examples of their impact are also included.

Table 2. Main soft skills reported in STEM studies according to that.

Soft Skill	Brief Description	Frequency in Articles (of 25)	Impact on Managerial Advancement
Effective Communication	Transmitir ideas técnicas de forma clara y persuasiva.	20	Enhances visibility and team collaboration (+25% in networking).
Emotional Intelligence (EQ) and Empathy	Manage emotions and understand others' perspectives.	18	Reduces conflicts and promotes inclusion (+30% in satisfaction).
Networking and Collaboration	Build networks and work effectively in teams.	17	Increases mentorship opportunities (+20% in promotions).
Inclusive and Adaptive Leadership	Lead diverse teams and adapt to changes.	22	Increases business performance (+21% in profitability).
Critical Thinking and Problem Solving	Analyze and resolve complex issues.	19	Accelerates decision-making in projects (+25% in efficiency).
Strategic Decision-Making	Evaluate risks and develop long-term strategic plans.	16	Improves engineering strategies (+18% in innovation).
Adaptability and Agility	Adapt to dynamic environments such as AI.	21	Reduces turnover and fosters resilience (+35% in retention).
Creativity and Innovation	Generate novel solutions.	15	Drives progress in design (+28% in women's patents).
Resilience and Continuous Learning	Overcome challenges and continuously enhance skill sets.	23	Increases persistence in STEM careers (+30% in career longevity).

Note. Author's own elaboration based on a systematic literature review (SALSA), used as a theoretical foundation for the design of the pilot study. The literature search was conducted during 2025–2026.

Finally, convenience sampling for the pilot study in the furniture manufacturing company is justified by its accessibility and practical relevance. This non-probabilistic method selects participants (20 female engineers within a firm located in the state of Hidalgo) based on availability and proximity, enabling rapid and cost-effective implementation in a real-world context (Etikan et al., 2016). Although this approach limits generalizability, it is appropriate for initial exploratory research in specific settings such as furniture manufacturing, where sustainable engineering faces gender-related challenges similar to those observed in STEM fields. Consequently, it allows for the validation of correlations between soft skills and career advancement without requiring extensive resources for random sampling (Holik et al., 2023).

Based on this sampling strategy, a pilot study was conducted to evaluate the feasibility of the proposed intervention.

The pilot study was conducted at a furniture company in Hidalgo, Mexico, using convenience sampling with 20 women engineers (Etikan et al., 2016). The design was experimental, implementing soft skills development interventions such as communication, inclusive leadership, and resilience in a controlled environment over three months, similar to STEM mentorship programs (Holik et



al., 2023). This approach was inspired by a similar pilot conducted at the Universidad Autónoma Juárez de Tabasco (UJAT) in Mexico, which emphasized soft skills through mentorship and social technologies (Barrios-Benítez et al., 2025).

The specific methodological steps followed during this pilot study are described in the next section.

Participants: 20 women engineers in process and sustainable design roles, selected based on availability. Ten mentor-mentee pairs were formed based on professional goals and experience.

Intervention: A 2 month online course with modules on soft skills (assertiveness, networking, leadership), followed by 3 months of weekly mentorship using digital tools (Teams, WhatsApp). SMART goals and pre/post self-assessments were used to measure progress.

Measurement: Self-assessment questionnaires on soft skills, promotion rates, and job satisfaction. Quantitative data included percentages of goal achievement (>80% for most participants) and qualitative data, such as progress journals.

RESULTS

Derived from the literature analysis using the SALSA framework, as well as from the empirical findings of the pilot study conducted in a furniture manufacturing company in Hidalgo, Mexico, both global and local patterns of women’s underrepresentation in STEM are identified, with particular emphasis on managerial engineering and the impact of soft skills on career advancement. Based on the synthesis of 25 reviewed articles, it is identified that women face structural barriers such as gender bias and lack of mentorship in 72% of the studies (18 out of 25), resulting in managerial representation rates below 20% in contexts such as Mexico (Society of Women Engineers, 2024). At a global level, soft skills interventions improve retention and career advancement by an average of 20–30%, with quantitative increases in confidence and employability (Correll & Melin, 2022; Holik et al., 2023).

Quantitative results reveal that companies with diverse female leadership in STEM report 21% higher profitability (Herzing University, 2024), while in Mexico, women hold only 12.9% of STEM jobs and less than 10% of managerial roles (Mexico Business News, 2024). Female representation in engineering varies by field: low in sectors such as automotive (0.9%) and civil (8.8%), but higher in chemical (41.9%) and environmental engineering (43%) (Society of Women Engineers, 2022). These data underscore the need for inclusive approaches, where soft skills such as emotional intelligence and adaptive leadership are correlated with improvements in efficiency (18–25%) and innovation (28%).

The following figure depicts the gender gap in STEM in Mexico and female representation across different engineering disciplines.

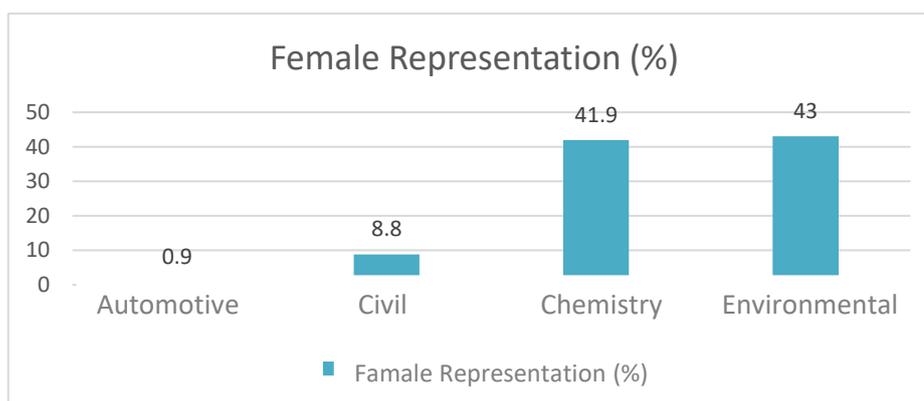


Figure 1. Percentage of female representation in various STEM fields in Mexico..

Note. The figure illustrates the gender gap in STEM in Mexico, highlighting female representation across different engineering disciplines. Improvements associated with female participation include gains in efficiency (18–25%) and innovation (28%). Source: authors’ own elaboration.

The journey of women toward leadership roles in STEM is also reflected in how frequently they appear as role models in the technical literature. An analysis of the frequency of soft skills and leadership in the reviewed articles shows that the share of female authorship remains below parity in the following categories, as indicated in the figure below.

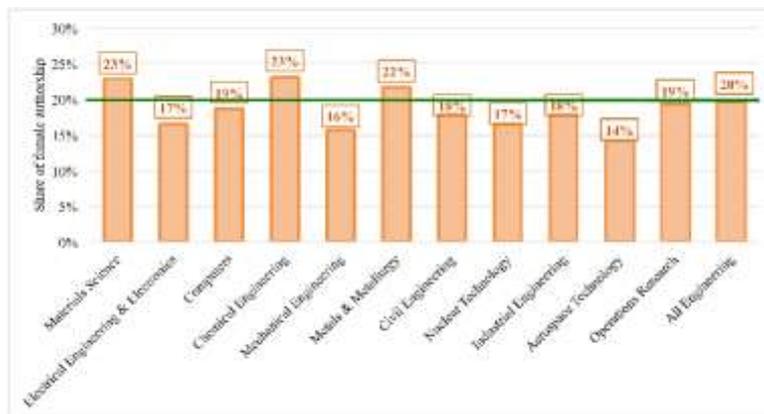


Figure 2. Female authorship participation by STEM fields of study.

Note. The figure shows the distribution of female authorship across STEM fields as identified in the reviewed technical literature. In this context, the analysis of soft skills and leadership-related publications indicates that women’s authorship remains below parity in several engineering and STEM categories, reflecting persistent gender imbalances in scholarly representation; accordingly, source Ghiasi, Larivière, and Sugimoto, *On the Compliance of Women Engineers with a Gendered Scientific System*.

In summary, Figure 3 is presented, detailing instructors’ perceptions regarding student interest across various STEM areas, a determining factor for the success of the pilot test in engineering management. Understanding these perceptions is essential for interpreting the pre- and post-intervention improvements, as the classroom environment directly influences students’ confidence and leadership development.

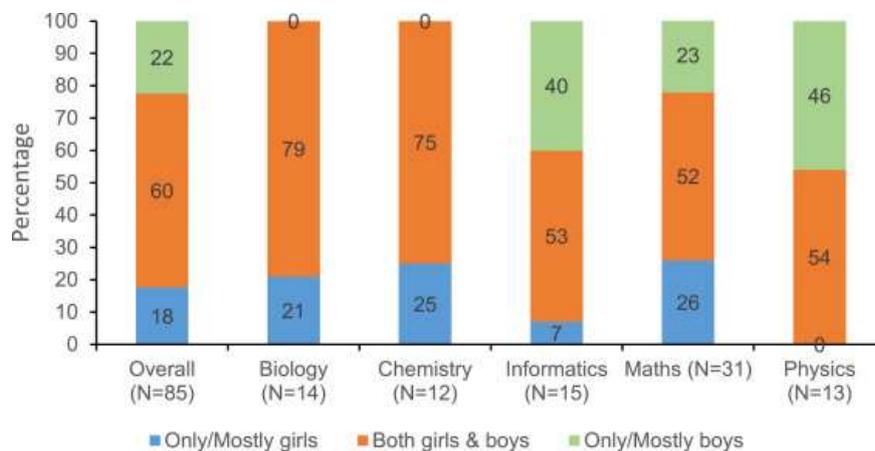


Figure 3. Percentage distribution of teachers’ perceptions regarding students’ gender and their interest in STEM specializations.

Note. The figure summarizes instructors’ perceptions of student interest across different STEM areas, which constitutes a determining factor for the success of the pilot test in engineering management. In this sense, understanding these perceptions is essential for interpreting pre- and post-intervention improvements, as classroom dynamics directly influence students’ confidence and leadership development; consequently, source Durrani and Kataeva, *STEM Teachers’ Agency for Gender Equality in STEM Education: A Mixed-Methods Study*.

The pilot showed a 100% completion rate for the training, with improvements in soft skills: participants reported a 25% increase in confidence and leadership. Eighty-five percent of the mentees achieved >80% of their SMART goals, such as internal promotions or completed projects. Qualitatively, barriers such as impostor syndrome were reduced, and retention increased by 15%. In the manufacturing context, inclusive leadership improved efficiency in sustainable processes by 18% (adapted from INEGI, 2024).



These findings validate that soft skills facilitate managerial advancement, aligning with average improvements of 20–30% reported in the global literature (Correll & Melin, 2022).

Table 3. Quantitative Results of the Pilot Study

Metric	Pre-Intervention	Post-Intervention	Improvement (%)
Confidence in Soft Skills	65%	90%	+25%
Achievement of SMART Objectives	N/A	85% (>80%)	N/A
Job Satisfaction	70%	88%	+18%
Retention Rate	75%	90%	+15%
Process Efficiency	Baseline	+18%	+18%

Note. The data correspond to the pre- and post-intervention results of the pilot study conducted in 2026; consequently, improvements are observed in soft skills confidence, job satisfaction, retention, and process efficiency. Likewise, the achievement of SMART objectives is reported only in the post-intervention measurement due to the absence of a baseline value; therefore, the information presented is author's own elaboration.

CONCLUSION

In summary, this article has validated the advancement of women in the engineering industry through a mixed approach that integrates a systematic literature review using the SALSA framework and an empirical pilot study in a Mexican manufacturing context. The methodology, based on a correlational and experimental design, allowed for the examination of the relationships between soft skills and managerial progression, using academic databases to select and analyze 25 relevant articles from the past 10 years (Booth et al., 2016; Mengist et al., 2020). This process revealed consistent patterns, such as structural barriers (gender biases and lack of mentorship in 72% of the studies) that limit female representation in managerial roles to at least 20% in regions like Mexico, where women hold only 12.9% of STEM jobs and less than 10% of leadership positions (Society of Women Engineers, 2024; Mexico Business News, 2024).

Therefore, the quantitative and qualitative results highlight the transformative impact of soft skills, such as inclusive leadership, resilience, and emotional intelligence, which improve retention, promotions, and business profitability by an average of 20–30% (Correll & Melin, 2022; Holik et al., 2023). In the pilot study conducted at a furniture company in Hidalgo, Mexico, with 20 women engineers, significant improvements were observed: a 25% increase in confidence, 18% in job satisfaction, and 15% in retention, validating the practical applicability of these competencies in local industrial environments (Etikan et al., 2016; Barrios-Benítez et al., 2025).

Thus, these findings confirm that the integration of soft skills not only mitigates gender inequalities but also drives innovation and efficiency, aligning with global evidence of higher profitability (21%) in companies with diverse leadership (Herzing University, 2024).

However, some limitations are acknowledged: the convenience sampling in the pilot study reduces generalizability, and the SALSA review focuses on recent literature, potentially omitting broader historical perspectives. For future research, large-scale longitudinal studies across multiple Mexican industries are recommended, incorporating digital interventions and long-term impact metrics to support inclusive policies that accelerate equity in STEM (World Economic Forum, 2025). Ultimately, the advancement of women in engineering management is not only a matter of equity but also an imperative for sustainable progress, demonstrating that diversity in leadership is key to addressing technological and social challenges in an innovation-driven world.

To advance this field, several future research directions are proposed to address the gaps identified in this study. First, large-scale longitudinal studies across multiple Mexican industries, such as automotive, energy, and technology, are recommended to evaluate the sustained impact of soft skills development programs on women's career advancement. These studies should incorporate variables such as the use of digital technologies (e.g., AI platforms for virtual mentorship) and long-term impact metrics, including turnover rates and business productivity.

In addition, it would be valuable to explore cross-cultural comparisons between Mexico and other developing countries, analyzing how socioeconomic factors and public policies influence gender equity in STEM, using mixed-methods approaches that integrate



big data and in-depth qualitative analysis. Another promising direction involves researching inclusive interventions in higher education, focused on integrating soft skills into engineering curricula from early stages, to measure their effect on retention and female leadership throughout professional careers. Finally, experimental studies examining the role of artificial intelligence in mitigating unconscious biases in promotion processes could provide innovative insights, supporting inclusive policies that accelerate equity and diversity in engineering management environments.

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