

OVERCOMING THE GLASS CEILING SYNDROME THROUGH DIGITALIZATION AND ARTIFICIAL INTELLIGENCE IN GCC COUNTRIES

SUPERANDO A SÍNDROME DO TETO DE VIDRO POR MEIO DA DIGITALIZAÇÃO E DA INTELIGÊNCIA ARTIFICIAL NOS PAÍSES DO CCG

Article received on: 12/08/2025

Article accepted on: 03/09/2026

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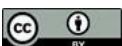
The authors declare that there is no conflict of interest

Abstract

This study investigates the potential of digitalization and Artificial Intelligence (AI) to dismantle the "glass ceiling" syndrome affecting women's career advancement in the Gulf Cooperation Council (GCC) region. Despite high levels of educational attainment among women, particularly in STEM fields, invisible systemic barriers and traditional socio-cultural norms continue to restrict their ascent to senior executive roles. Employing a mixed-methods research design, the study utilizes a quantitative survey of 385 valid participants alongside 23 semi-structured interviews with senior HR executives across the UAE, Saudi Arabia, and Qatar. The research evaluates how digital tools can decouple professional output from physical presence, mitigating the reliance on visibility-based metrics that often disadvantage women in conservative business environments. Findings indicate that while AI-driven talent management offers a mechanism for standardizing evaluation criteria and reducing unconscious bias, it simultaneously poses risks of algorithmic bias if trained on historical, male-dominated datasets. The study concludes that the strategic alignment of human oversight, ethical governance (such as

Resumo

Este estudo investiga o potencial da digitalização e da Inteligência Artificial (IA) para eliminar a síndrome do "teto de vidro" que afeta o avanço na carreira das mulheres na região do Conselho de Cooperação do Golfo (CCG). Apesar dos altos níveis de escolaridade entre as mulheres, particularmente nas áreas de ciência, tecnologia, engenharia e matemática (STEM), barreiras sistêmicas invisíveis e normas socioculturais tradicionais continuam a restringir sua ascensão a cargos executivos de alto escalão. Empregando um desenho de pesquisa de métodos mistos, o estudo utiliza uma pesquisa quantitativa com 385 participantes válidos, juntamente com 23 entrevistas semiestruturadas com executivos seniores de RH nos Emirados Árabes Unidos, Arábia Saudita e Catar. A pesquisa avalia como as ferramentas digitais podem dissociar o desempenho profissional da presença física, mitigando a dependência de métricas baseadas na visibilidade que frequentemente colocam as mulheres em desvantagem em ambientes de negócios conservadores. Os resultados indicam que, embora a gestão de talentos impulsionada pela IA ofereça um mecanismo para padronizar



AI ethics boards), and technical upskilling for HR professionals is essential to leverage technology as a catalyst for gender equity and competitive advantage in the GCC corporate sector.

Keywords: Artificial Intelligence (AI). Digitalization. Glass Ceiling. Gender Inequality. Women's Career Advancement. GCC. Algorithmic Bias. Talent Management. Ethical AI. Human Resource Management.

cr terios de avalia o e reduzir o vi s inconsciente, ela simultaneamente apresenta riscos de vi s algor tmico se treinada com conjuntos de dados hist ricos dominados por homens. O estudo conclui que o alinhamento estrat gico entre supervis o humana, governan a  tica (como conselhos de  tica em IA) e capacita o t cnica para profissionais de RH   essencial para alavancar a tecnologia como um catalisador para a equidade de g nero e vantagem competitiva no setor corporativo do CCG.

Palavras-chave: Intelig ncia Artificial (IA). Digitaliza o. Teto de Vidro. Desigualdade de G nero. Avan o na Carreira das Mulheres. GCC. Preconceito Algor tmico. Gest o de Talentos. IA  tica. Gest o de Recursos Humanos.

1 INTRODUCTION

The Gulf Cooperation Council region is currently undergoing a profound economic and social transformation driven by rapid digitalization and the integration of artificial intelligence across various sectors. This technological shift presents a unique opportunity to address persistent structural barriers, such as the glass ceiling syndrome, which continues to hinder women's advancement into leadership positions despite ongoing national empowerment initiatives (Meharunisa et al., 2024. Alhmoudi and Rashid, 2025). The private sector is undergoing a significant transformation because of digitalization, as evidenced by businesses increasingly integrating innovative technologies such as AI, the Internet of Things, and blockchain to boost operational efficiency and productivity (Fareed et al., 2025). Despite these advancements, the current AI revolution is marked by persistent challenges, including issues of gender-based discrimination, unequal compensation, and limited opportunities for women's career advancement (Wo zniak-J chorek, Rydzak and Ku zmar, 2023). Gender prejudice and stereotypes remain prevalent in the workplace, particularly within the technology sector, where they significantly hinder professional development and constrain prospects for growth (Meharunisa et al., 2024). Consequently, there is a critical need to explore how digital transformation and AI-driven solutions can be strategically leveraged to dismantle

these barriers, foster inclusive organizational cultures, and unlock the full potential of the female workforce in the GCC (Meharunisa et al., 2024. Fareed et al., 2025). This study investigates the intersection of technological advancement and gender dynamics, specifically examining how digital tools and AI applications can mitigate unconscious bias in recruitment and promotion processes while creating new pathways for women to ascend to senior management roles (Weber-Lewerenz, 2021. Albous, Balakrishnan and Al-Jayyousi, 2025). By analyzing the mechanisms through which algorithmic decision-making can standardize evaluation criteria, this research aims to provide empirical evidence on the efficacy of technology-driven interventions in promoting gender equity within the corporate hierarchies of the Gulf states (Woźniak-Jęchorek, Rydzak and Kuźmar, 2023. Alhmoudi and Rashid, 2025). The following sections review the existing academic literature to establish a comprehensive understanding of the glass ceiling phenomenon, trace the historical evolution of women's leadership in the Gulf region, and evaluate the limitations of previous policy interventions.

2 LITERATURE REVIEW

The literature on gender disparities in leadership positions reveals ongoing challenges and emerging strategies aimed at fostering greater gender equity, with persistent obstacles including gender biases, stereotypes, limited access to networks, and restrictive cultural norms that continue to constrain women's advancement into senior roles (Elkhwesky, Salem and Manzani, 2023. Al-Naqbi and Aderibigbe, 2024). This phenomenon is particularly pronounced in professional and technical sectors within the GCC, where a notable imbalance exists in fields such as technology, energy, and manufacturing, with men significantly outnumbering women in leadership positions (Alhmoudi and Rashid, 2025).

3 DEFINING THE GLASS CEILING SYNDROME

The glass ceiling syndrome refers to the invisible, systemic barriers that prevent women and minorities from advancing beyond a certain level in the corporate hierarchy,

despite their qualifications and achievements (Srivastava and Nalawade, 2023). This concept encompasses personal, organizational, and societal barriers that restrict access to prestige, revenue, and top managerial roles, creating a pervasive obstacle across various career fields (KAUR and MITTAL, 2022). These barriers are often reinforced by traditional gender role expectations and organizational practices that undervalue women's contributions, resulting in significant underrepresentation in upper management despite high levels of educational attainment in science and technology fields (Al-Naqbi and Aderibigbe, 2024. Alhmoudi and Rashid, 2025). In the Middle Eastern context, this phenomenon is particularly acute, as female managers encounter the glass ceiling more frequently and to a greater extent compared to their counterparts in other regions, often exacerbated by factors such as lack of support, destructive work relationships, and overt gender discrimination (Jrasat and Zubaidi, 2024). Furthermore, recent scholarship suggests that the application of Western organizational constructs to the Middle East requires nuance, as some studies indicate that workplace injustice must be analyzed through sophisticated organizational and political features specific to individual countries rather than generalized regional assumptions (Rodríguez, Ridgway and Kemp, 2019). Sidani and Feghali (Rodríguez, Ridgway and Kemp, 2019) argue that over-generalization of commonalities between Middle Eastern countries has obscured significant inter-country variations, leading to a lack of recognition regarding how women are increasingly navigating shifting societal roles and labor market participation.

4 HISTORICAL CONTEXT OF WOMEN IN LEADERSHIP IN GCC COUNTRIES

The trajectory of women's professional advancement in the Gulf Cooperation Council has been shaped by a complex interplay of socio-cultural norms, state-led modernization efforts, and evolving economic imperatives. While early educational reforms and labor nationalization policies significantly increased female participation in the workforce, traditional patriarchal structures and organizational practices have often restricted their upward mobility to middle management rather than senior executive roles (Lathabhavan and Balasubramanian, 2017. Khanche and Kahla, 2018). This disparity is particularly evident in technology-based organizations, which remain male-dominated at

the management level despite the fact that women comprise the majority of STEM graduates in the GCC region (Alhmodi and Rashid, 2025). This paradox highlights a disconnect between educational attainment and labor market outcomes, where institutional policies and societal norms collectively impede the translation of academic credentials into leadership authority (Al-Naqbi and Aderibigbe, 2024).

5 PREVIOUS INTERVENTIONS AND THEIR LIMITATIONS

Efforts to address gender disparities in the GCC have included policy reforms and organizational initiatives, yet these measures have often fallen short due to a lack of supportive workplace practices such as flexible working arrangements and robust mechanisms to prevent discrimination and harassment (Rodríguez, Ridgway and Kemp, 2019). For instance, research conducted among female Emirati leaders indicates that policies designed to promote inclusion are frequently perceived as ineffective, with participants citing persistent barriers to career progression and disparities in institutional support as major impediments (Al-Naqbi and Aderibigbe, 2024). Consequently, there is a growing recognition among scholars that structural interventions must move beyond superficial policy changes to address the deep-seated organizational and economic conditions that sustain gender inequality (Rodríguez, Ridgway and Kemp, 2019. Alhmodi and Rashid, 2025). Digitalization offers a transformative mechanism to circumvent these entrenched barriers by restructuring traditional workflows and enabling remote work environments that can mitigate the impact of restrictive cultural norms on women's professional participation. Digital transformation facilitates this shift by decoupling professional output from physical presence, thereby reducing the reliance on traditional networking models and client-facing requirements that often disadvantage women in conservative societies (Al-Asfahani, Hebson and Bresnen, 2022). However, while digital transformation enhances learning and operational efficiency, it does not fully address workplace diversity challenges without targeted interventions to dismantle the structural barriers embedded in organizational cultures (Aldossari, 2025. Arabi et al., 2025). Digitalization fundamentally alters the operational landscape by introducing data-driven decision-making processes and automated workflows that can objectively assess performance, thereby reducing the subjective biases that often hinder women's

advancement in traditional corporate structures (Aldossari, 2025. Figueroa and Lemus, 2025). By leveraging cloud-based collaboration tools and virtual platforms, organizations can create meritocratic environments where professional contributions are evaluated based on tangible outputs rather than visibility in traditional male-dominated social networks (Salman, Fawzy and Zaazou, 2025). Remote work options and flexible arrangements are particularly critical in this context, as they allow women to balance professional responsibilities with domestic duties that are culturally prescribed, thereby reducing the career interruptions that often stall advancement (Aly, 2020. Escudero-Guirado, Fernández-Rodríguez and Sánchez, 2024). Despite these potential benefits, critics argue that technological solutions alone cannot dismantle the deep-seated cultural norms and organizational structures that perpetuate gender inequality, as digital tools may simply replicate existing biases if not implemented with deliberate equity-focused strategies (Ryan, 2022. Araneda-Guirriman et al., 2023). Therefore, the integration of digital technologies must be accompanied by comprehensive organizational change management to ensure that the shift towards virtual environments actively promotes inclusivity rather than reinforcing existing hierarchies (Weber-Lewerenz, 2021. Xu, She and Liu, 2022). Digital technologies have enabled human resource professionals to collect, analyze, and report on diversity, equity, and inclusion metrics using AI-powered tools, thereby proactively addressing workplace challenges to create a more inclusive environment (Akter et al., 2023). However, the implementation of these digital solutions is not without risk, as poorly designed algorithms and automated systems can inadvertently perpetuate or even exacerbate existing gender inequalities if they are not developed with fair and inclusive policies in mind (Yusuf et al., 2023). Specifically, algorithms in AI often replicate prevailing biases and discrimination from the physical world, transferring patriarchal orders and traditional gender roles into the digital space (Aydın, Rahman and Özeren, 2023).

6 THE ROLE OF DIGITALIZATION IN WORKPLACE

Transformation Digitalization fundamentally reshapes organizational structures by decoupling professional output from physical presence, thereby challenging the traditional visibility-based metrics that often disadvantage women in conservative business environments.

This decoupling allows for the implementation of flexible work arrangements and remote collaboration tools that can support employees who bear significant caregiving responsibilities, a burden that disproportionately affects women in the region (Valdés et al., 2022). While this shift presents significant opportunities for enhancing work-life balance and career continuity, it simultaneously introduces complex tensions regarding professional visibility and social integration that may inadvertently hinder women's advancement if not strategically managed (Villamor et al., 2022). Furthermore, the rapid integration of automation and AI-driven systems into the workplace necessitates a continuous evolution of skill sets, creating a dynamic where employees must perpetually adapt to new technological requirements to maintain their professional standing (Malik et al., 2024). This transformation extends to human resource practices, where the adoption of AI-driven administrative tools enables departments to automate routine tasks and shift their focus toward strategic planning and talent development (Singh and Shaurya, 2021. García-Fernández, Ortiz-de-Urbina-Criado and García-López, 2024). Despite the potential for increased efficiency, the deployment of AI in human resources carries significant risks of algorithmic bias that can undermine efforts to promote gender equality (Kshetri, 2021. Sony et al., 2025). For example, studies indicate that AI systems often rely on historical data derived from male-dominated environments, leading to outcomes where female candidates are systematically underestimated or excluded from high-tech positions (Aydın, Rahman and Özeren, 2023). This phenomenon is particularly concerning given that women face a higher risk of job displacement due to AI-driven automation in routine-based roles, while the significant underrepresentation of women among AI professionals—comprising only sixteen percent of the workforce in regions like the EU and UK—raises the risk that digital futures will be designed predominantly by male perspectives (Aydın, Rahman and Özeren, 2023). Such bias is particularly problematic because AI is often developed and trained on datasets based on men, creating

a substantial risk that these technologies will amplify rather than mitigate the gender gap in the future (Sironić and Dabić, 2025). Conversely, when designed and implemented with rigorous ethical standards, AI applications in human resources offer a transformative opportunity to identify and correct discriminatory practices that have historically marginalized women in the workplace (Carstensen and Ganz, 2023). However, realizing this potential requires addressing the inherent risks of algorithmic bias, as AI systems trained on historical data often reinforce societal stereotypes and discriminatory outcomes that can exacerbate pre-existing gender disparities (Carstensen and Ganz, 2023. Rane, 2024). To mitigate these risks, organizations must prioritize value co-creation through collaboration between human resources professionals and software development teams to ensure that diverse perspectives inform the design and deployment of AI systems (Aydın, Rahman and Özeren, 2023). This collaborative approach is essential because algorithm biases frequently result from training data that reproduces existing organizational biases in employment practices, necessitating active involvement from HR professionals to reach collective consensus and promote social acceptability (Tinguely, Lee and He, 2023).

7 THEORETICAL FRAMEWORK

This section establishes the foundational theories that explain how gender norms are constructed and maintained within organizational structures, while also providing a lens to evaluate how digital technologies can disrupt these entrenched patterns to create competitive advantage. Social Role Theory posits that gender stereotypes arise from the historical division of labor, wherein men are typically associated with agentic roles focused on independence and assertiveness, while women are relegated to communal roles centered on cooperation and nurturing (Tinguely, Lee and He, 2023). These socially constructed expectations create implicit biases that influence leadership evaluations, often resulting in the perception that women lack the requisite traits for executive positions despite possessing the necessary competencies (Sivakaminathan and Musi, 2025). In the context of the GCC, these traditional gender roles are further reinforced by cultural and religious norms that emphasize distinct spheres of influence for men and women, thereby creating a unique barrier to entry for women seeking to ascend to senior leadership roles

within conservative corporate structures. Consequently, these implicit biases often result in the undervaluation of women's contributions and the perpetuation of discriminatory practices that hinder their professional advancement, particularly in male-dominated industries where agentic traits are disproportionately prized (Pethig and Kroenung, 2022). The persistence of these stereotypes creates a significant disconnect between women's actual capabilities and the perceived suitability for leadership, often leading to a "lack of fit" explanation for their underrepresentation in high-status positions. To counteract these entrenched biases, digitalization offers a mechanism to decouple professional output from physical presence, thereby reducing the reliance on visibility-based metrics that often disadvantage women in traditional office environments (Chen, 2023). By shifting the evaluation criteria to objective performance data rather than subjective observations of behavior, digital platforms can mitigate the impact of second-generation bias that stems from these socially constructed gender expectations (Ramseook-Munhurrun, Naidoo and Armoogum, 2023). According to this theoretical perspective, women are systematically disadvantaged due to institutionalized discrimination that restricts their access to critical resources, thereby creating observed performance gaps that are erroneously attributed to inherent gender differences rather than structural inequities (Lee et al., 2022). This misattribution is particularly problematic because it obscures the systemic nature of the barriers women face, shifting the focus from organizational reform to individual deficiency (Lawson et al., 2022).

8 SOCIAL ROLE THEORY AND GENDER STEREOTYPES

Social Role Theory provides a critical lens for understanding how descriptive and prescriptive stereotypes function as barriers to women's career advancement, particularly through the characterization of women as communal rather than agentic, which conflicts with the perceived demands of leadership roles (Heilman, Caleo and Manzi, 2023). Ramseook-Munhurrun, Naidoo and Armoogum, 2023). Role congruity theory further elucidates this dynamic by demonstrating that the perceived mismatch between feminine attributes and the requirements of leadership positions generates prejudice and undermines women's authority in professional settings (Lux et al., 2025). This prejudice manifests through descriptive biases, where women are assumed to lack the qualities

necessary to lead, and prescriptive biases, where they face negative judgment for displaying leadership behaviors that are perceived as incongruent with traditional feminine norms (Ramseook-Munhurrun, Naidoo and Armoogum, 2023. Mohamadamin and Shabila, 2025). Such role incongruity creates a double bind for female leaders, who are penalized for failing to exhibit the assertiveness expected of executives while simultaneously facing social sanctions for violating gender norms when they do display agentic behavior (Shirley and Feitosa, 2024). This systemic disadvantage is further compounded by the tendency for stakeholders to conflate a leader's gender with the quality of the initiatives they manage, often resulting in the undervaluation of projects led by women regardless of actual performance outcomes (Parker, Mui and Titus, 2019). Research indicates that this incongruity between leadership role expectations and gender role expectations imposes a significant cost on women, as evaluators often rely on stereotypes rather than actual performance when conducting assessments, thereby perpetuating systematic bias in performance evaluations (Hopkins et al., 2021. Heilman, Caleo and Manzi, 2023). Specifically, descriptive stereotypes lead to the assumption that women lack the hardiness and strategic vision required for senior management, while prescriptive stereotypes result in social penalties for women who engage in counter-stereotypical behaviors such as assertiveness or negotiation, as these actions are often attributed to negative internal dispositions rather than professional necessity (Sarwar and Imran, 2019. Heilman, Caleo and Manzi, 2023. Triana et al., 2023). Consequently, this dynamic creates a persistent barrier where women must navigate a narrow path of acceptable behavior to avoid backlash, limiting their ability to demonstrate the full range of leadership competencies required for executive advancement (Tan et al., 2021. Heilman, Caleo and Manzi, 2023). The psychological impact of these role incongruities extends beyond external evaluations to affect women's self-perception and leadership aspirations, as stereotype threat and internalized gender norms can discourage women from pursuing high-status positions or fully exercising their authority when attained (Lux et al., 2025. Papadakou and Sternberg, 2025).

9 RESOURCE-BASED VIEW OF THE FIRM AND COMPETITIVE ADVANTAGE

The Resource-Based View of the Firm posits that organizations can achieve sustained competitive advantage by leveraging resources that are valuable, rare, inimitable, and non-substitutable, suggesting that the systematic exclusion of women from leadership represents a significant inefficiency in the utilization of human capital. By failing to integrate the diverse cognitive perspectives and leadership styles that women bring to strategic decision-making, firms not only limit their talent pool but also forfeit the innovation potential inherent in a heterogeneous workforce, thereby constraining their ability to adapt to complex market dynamics (Lux et al., 2025). This theoretical framework implies that gender diversity in leadership constitutes a strategic asset that can enhance organizational performance through improved problem-solving capabilities and broader market insight, yet this potential remains largely untapped due to the structural barriers identified in the glass ceiling phenomenon (Brands and Fernandez-Mateo, 2016. Bark, Monzani and Dick, 2022). Consequently, organizations that successfully dismantle these barriers and integrate women into top management teams may realize a competitive edge, as the inclusion of diverse leadership perspectives has been linked to more robust strategic dialogue and enhanced firm performance outcomes (Chadwick and Dawson, 2018). However, the realization of this competitive advantage is often obstructed by the persistence of gender-based stereotypes that misattribute the unique challenges women face to individual deficiencies rather than structural barriers, thereby masking the true value of female leadership contributions (Parker, Mui and Titus, 2019. Galsanjigmed and Sekiguchi, 2023). Meta-analytic evidence suggests that female representation in upper echelons can positively influence firm performance through unique resource portfolios and improved team decision-processes, though these benefits are frequently offset by role incongruence perceptions that undermine the legitimacy of female leaders (Jeong and Harrison, 2016). To address this paradox, organizations must recognize that women represent an underutilized category of human capital whose distinct skills, competencies, and knowledge bases constitute socially complex resources that are difficult for competitors to imitate (Campos-García and Vicente, 2022).

Greater gender diversity in an organization's workforce and senior management is considered a source of intangible and socially complex resources that may improve the organization's performance, as a higher level of gender diversity introduces multiple and distinct skills, abilities, competences, knowledge, opinions, and backgrounds (Campos-García and Vicente, 2022). The upper echelons theory further supports this perspective by positing that the strategic outcomes of an organization are a reflection of the demographic composition and cognitive models of its top management team, implying that gender diversity in leadership directly influences the breadth of strategic alternatives available to the firm (Sánchez, Diaz and Urbano, 2023). This theoretical alignment suggests that the cognitive heterogeneity introduced by gender-balanced leadership teams enhances the organization's capacity to identify and exploit strategic opportunities, thereby fostering a more comprehensive understanding of the competitive landscape (Hedija and Němec, 2020. Campos-García and Vicente, 2022). Despite the theoretical promise of gender diversity as a source of competitive advantage, the practical realization of these benefits is often hindered by the double-edged nature of diversity, where the potential for enhanced innovation and decision-making quality can be undermined by negative interpersonal dynamics and role incongruity (Chadwick and Dawson, 2018). Therefore, the strategic value of female leadership is contingent upon the organization's ability to mitigate these social frictions and create an environment where the intellectual capital and unique competencies of women can be fully leveraged to drive competitive advantage (Hoobler et al., 2016. Isola, Adeleye and Olohunlana, 2020). Research indicates that increasing female presence in male-dominated leadership teams creates a strategic advantage that can promote more efficient practices overall, while the likelihood of company growth is improved when women hold senior management roles (Chadwick and Dawson, 2018. Kong et al., 2024). This alignment between gender diversity and organizational performance is further reinforced by the resource-based view, which emphasizes that unique assets such as human capital and technological capabilities enable firms to implement strategies that enhance efficiency and long-term performance (Alhmoudi and Rashid, 2025). Specifically, the integration of women into senior management roles is associated with a broader focus on long-term strategic goals rather than short-term profit maximization, a characteristic that is particularly advantageous for organizations pursuing innovation strategies in uncertain environments (Xiu et al., 2017).

This strategic orientation is further supported by evidence that female leaders often demonstrate a heightened sensitivity to negative market feedback and environmental cues, enabling organizations to maintain the strategic flexibility necessary for sustained competitive advantage (Xiu et al., 2017).

This perspective is further substantiated by empirical findings that verify a significantly positive relationship between women in leadership roles and corporate innovation, as gender-based diversity among top management impacts strategic decision-making processes (Kong et al., 2024). Specifically, female representation in top management can bring diverse viewpoints, capabilities, knowledge, and customs which improve the functions and outcomes of the organization (Fuertes and Herrera, 2023. Kong et al., 2024). However, the realization of these benefits is not automatic, as literature suggests that workforce heterogeneity can generate conflicts driven by differences in values and beliefs, potentially creating barriers to cooperation and communication that may negatively impact innovation outcomes (Foss et al., 2021). Nevertheless, when effectively managed, the distinct cognitive resources and varied life experiences inherent in diverse management teams can facilitate the acquisition of common goals, thereby increasing the probability of obtaining innovative outcomes (García, Lara and Chicón, 2022. Kong et al., 2024). Furthermore, the presence of women on boards has been shown to exert a favorable impact on both the quantity and quality of green innovations, while gender diversity more broadly enhances companies' reputations, creativity, and problem-solving capacities, thereby increasing the probability of obtaining innovative outcomes (García-Meca, Ramón-Llorens and Martínez-Ferrero, 2023. Xing et al., 2023).

10 DIFFUSION OF INNOVATION THEORY

Diffusion of Innovation Theory provides a critical lens for understanding how digitalization and artificial intelligence technologies can be adopted within GCC organizations to dismantle structural barriers facing women, positing that the rate at which these transformative tools are accepted depends on their perceived relative advantage over traditional, exclusionary practices. According to Rogers, this relative advantage is one of the primary determinants of the rate of adoption, suggesting that digital tools must demonstrate clear superiority in facilitating meritocratic advancement

and remote collaboration to overcome the inertia of established cultural norms. Compatibility with existing values is another crucial factor, as digital solutions must align with the socio-cultural fabric of GCC societies to ensure acceptance among decision-makers who may otherwise resist changes to traditional gender dynamics. Complexity, or the degree to which these technologies are perceived as difficult to understand and implement, also plays a significant role, as user-friendly interfaces and intuitive design are essential to encourage widespread adoption among stakeholders who may lack technical proficiency. Trialability, the extent to which these innovations can be experimented with on a limited basis, is particularly relevant in the GCC context, where organizations may prefer to pilot digital HR initiatives in specific departments before scaling them across the enterprise to mitigate risk and assess cultural fit.

Finally, observability, or the degree to which the results of adopting these technologies are visible to other members of the organization, is essential for demonstrating the tangible benefits of digital and AI-driven equity initiatives, thereby creating a feedback loop that encourages further adoption and institutionalization of these transformative practices. The successful diffusion of these technologies is further contingent upon the perceived compatibility of AI-driven systems with existing organizational workflows and cultural values, as research indicates that incompatible inventions are less adopted than compatible ones, highlighting the necessity for solutions that integrate seamlessly with current practices (Akour et al., 2025).

11 METHODOLOGY

This study employs a quantitative research design to investigate the relationship between digitalization, artificial intelligence adoption, and the mitigation of the glass ceiling syndrome for women in leadership positions across GCC countries (Al-Ayed and Al-Tit, 2024). A cross-sectional survey approach was selected to capture a comprehensive snapshot of the current organizational landscape, allowing for the simultaneous examination of multiple variables including digital tool usage, AI implementation in human resources, and perceived career barriers among female professionals (Woźniak-Jęchorek, Rydzak and Kuźmar, 2023. Al-Ayed and Al-Tit, 2024). The survey instrument was developed using validated scales from prior literature to ensure reliability and

validity, with specific constructs adapted to measure the extent of digitalization, the utilization of AI in human resources processes, and the subjective experiences of gender-based career obstacles (Singh and Shaurya, 2021. Meharunisa et al., 2024). The research design is grounded in a positivist paradigm, which facilitates the testing of hypothesized relationships between technological adoption and career progression outcomes through statistical analysis, thereby enabling the identification of significant patterns across the sampled population (Park, Woo and Kim, 2024. Mahade et al., 2025).

12 RESEARCH DESIGN

The quantitative approach is operationalized through a deductive framework, where hypotheses derived from the theoretical underpinnings of Social Role Theory and the Diffusion of Innovation Theory are tested using structural equation modeling to assess the direct and indirect effects of digital interventions on gender parity in leadership (Meharunisa et al., 2024). This analytical strategy allows for the rigorous examination of complex causal pathways, specifically modeling how technological acceptance variables mediate the relationship between organizational digital maturity and the reduction of gender-based barriers to advancement (Al-Zahrani and Alasmari, 2025). Data collection was performed through a survey questionnaire distributed to an online quota sample consisting of full-time working professionals across the GCC region, designed to achieve a confidence level of 95% and a maximum margin of error of 0.04% (Woźniak-Jęchorek, Rydzak and Kuźmar, 2023). The questionnaire was administered electronically via Google Forms to ensure broad accessibility and data security, with the survey period spanning from March 2024 to July 2024 to capture a sufficient temporal window for response accumulation (Kutieshat et al., 2025). To minimize measurement error and ensure valid results, the survey instrument incorporated several methodological safeguards, including the assurance of participant anonymity and the confidentiality of personal data to reduce social desirability bias and encourage honest responses regarding sensitive gender dynamics (Alhmoudi and Rashid, 2025). The survey instrument was constructed using validated measurement scales adapted from established literature to ensure the reliability and validity of the constructs under investigation (Rasheed et al., 2024). The survey items were measured on a five-point Likert scale, where higher scores

indicated stronger agreement or more frequent utilization of digital and AI-driven tools, facilitating the precise quantification of latent variables such as perceived organizational support and technological self-efficacy (Alhmoudi and Rashid, 2025).

The survey was divided into two distinct sections: the first section gathered demographic information regarding the respondents' age, gender, educational attainment, and organizational tenure, while the second section contained 24 items assessing the dependent and independent variables related to digitalization and AI adoption (Mbaidin, 2023). The questionnaire was developed having drawn upon the normative literature and experience of the research team, with every attempt made to reduce embedded bias through rigorous checking and cross-checking of the translation and constructs within the research design (Chipeva et al., 2018). Prior to full deployment, the instrument underwent a rigorous expert review process and pilot testing to assess content validity and reliability (Jo and Park, 2024). The pilot study involved a small group of 30 participants representative of the target population to identify any ambiguities in the phrasing of questions and to estimate the time required for completion, with feedback used to refine the instrument for the main study (Senadjki et al., 2023. Shukla, Algnihotri and Singh, 2023). The final version of the survey was subsequently distributed to the target population of professionals across the GCC region, utilizing a stratified sampling approach to ensure adequate representation across key demographic variables such as industry sector, organizational size, and hierarchical level (Jo and Park, 2024).

The survey instrument was translated into Arabic to ensure linguistic accessibility and cultural relevance for respondents across the GCC region, with the translation process involving independent forward translation by bilingual experts followed by back-translation to verify semantic equivalence (Abu-Silake et al., 2024. Bai and Yang, 2025). This rigorous process was further supplemented by consultation with local academic experts to guarantee contextual relevance and cultural appropriateness of the terminology used (Razzouki, Hammou and Izenzal, 2025). Following the translation and validation procedures, the final survey instrument was hosted on a secure online platform and distributed to potential participants through professional networks and organizational channels to maximize reach and response rates (Alshammari and Al-Mamary, 2025. Belyamani et al., 2025). The data collection process yielded a total sample size of 419 completed responses, providing a robust dataset for statistical analysis and enabling the

examination of demographic characteristics across the target population (Al-Ayed and Al-Tit, 2024). The data collection process employed a non-probability sampling strategy, combining convenience and snowball sampling techniques to reach a diverse pool of professionals across the GCC region, as the absence of a comprehensive sampling frame for all sector employees precluded the use of random sampling methods (Al-Mamary et al., 2025). To mitigate potential selection bias inherent in non-probability methods, the survey was disseminated broadly across professional networks without restricting participation to specific demographic groups, thereby enhancing the diversity of the respondent pool (Hassan, 2025).

The final dataset was subjected to a rigorous screening process to ensure data quality, where incomplete responses and those exhibiting straight-lining patterns were excluded from the analysis to maintain the integrity of the statistical results (Ali et al., 2023).

Additionally, outlier detection procedures were implemented to identify and remove data points that deviated significantly from the central tendency of the distribution, ensuring that the final analytical sample accurately reflected the underlying population parameters (Al-Abbadi et al., 2024. Abdulmaksoud et al., 2025). After deleting the empty entries, 385 valid participants were used in the reporting of this study (Khalafallah, Soliman and Alrasheed, 2022). The demographic composition of the sample revealed a diverse distribution across gender, nationality, and organizational hierarchy, with 62% of respondents identifying as female and 38% as male, reflecting the targeted focus on capturing perspectives relevant to the glass ceiling phenomenon. In terms of organizational tenure, 45% of the participants had been employed with their current organizations for more than five years, while 24% had between three to five years of experience, providing a sufficient baseline to assess long-term career progression and the impact of digital interventions on leadership trajectories (Jrasat and Zubaidi, 2024). Regarding the hierarchical distribution of the sample, the majority of respondents occupied middle and upper management positions, with 57% holding senior roles that provided critical insights into the structural barriers and enablers of leadership advancement within the GCC context (Alhmodi and Rashid, 2025). The collected data were analyzed using SPSS 27.0 and AMOS 27.0, employing a two-step approach where confirmatory factor analysis and reliability assessment were conducted to verify the

validity and psychometric properties of the measurement scales (Lee and Shin, 2024). Structural equation modeling was subsequently utilized to examine the hypothesized relationships between digitalization, artificial intelligence adoption, and the glass ceiling syndrome, allowing for the simultaneous evaluation of direct and indirect effects within the proposed theoretical framework (Jasimuddin, Mishra and Almuraqab, 2017. Senadjki et al., 2023). To assess the normality of the data distribution, preliminary tests for skewness and kurtosis were conducted, with results indicating that the values fell within the acceptable threshold range of ± 2 , confirming the suitability of the data for parametric statistical analysis (Hanandeh et al., 2024). The structural equation modeling analysis was executed using AMOS software to evaluate the goodness-of-fit indices and test the proposed research framework (Moreira-Chóez et al., 2024. Nawaz et al., 2024). The evaluation of the model fit relied on multiple indices, including the Comparative Fit Index, Tucker-Lewis Index, and Root Mean Square Error of Approximation, to determine the adequacy of the proposed structural model (Moreira-Chóez et al., 2024. Nawaz et al., 2024). The results demonstrated that the model achieved a satisfactory fit, with the Comparative Fit Index and Tucker-Lewis Index exceeding the recommended threshold of 0.90, while the Root Mean Square Error of Approximation registered below 0.08, indicating that the hypothesized relationships were well-supported by the empirical data (KAUR and MITTAL, 2023. Kutieshat et al., 2025). Furthermore, the structural model assessment included the examination of path coefficients to determine the strength and direction of the relationships between latent variables, with values ranging from -1 to +1 indicating the nature of these associations (Sharabati et al., 2024). Statistical significance was established by evaluating the critical ratios and probability levels associated with each path coefficient, ensuring that the observed relationships were not attributable to random chance (Jeong, Kim and Lee, 2024. Alhmoudi and Rashid, 2025). To validate the survey instrument and ensure the robustness of the measurement model, a Confirmatory Factor Analysis was performed on all constructs to assess convergent and discriminant validity (Esmaeilzadeh, 2020). Convergent validity was established by examining the Average Variance Extracted and factor loadings, where all constructs demonstrated AVE values exceeding the recommended threshold of 0.50, indicating that the latent variables accounted for a substantial proportion of variance in their respective indicators (Sharabati et al., 2024). Discriminant validity was subsequently assessed using the Fornell-Larcker

criterion, which required that the square root of the Average Variance Extracted for each construct be greater than the correlations between that construct and all other constructs in the model (Ateş and Kölemen, 2024). The analysis confirmed that the square root of the AVE scores for each construct exceeded the squared correlations among the constructs, thereby affirming the distinctiveness of the data and the absence of multicollinearity issues (Megeirhi et al., 2020. Biswas et al., 2024). The structural model was evaluated using several goodness-of-fit indices to determine the adequacy of the proposed framework, with the Comparative Fit Index and Tucker-Lewis Index exceeding the recommended threshold of 0.90, while the Root Mean Square Error of Approximation registered below 0.08, indicating a close fit between the model and the observed data (Sjachriatin, Riyadi and Mujanah, 2023. Jabali et al., 2024. Mamdouh et al., 2025).

13 RESEARCH DESIGN

This study employs a quantitative, cross-sectional research design to systematically investigate the relationships between digitalization, artificial intelligence adoption, and the glass ceiling syndrome within the GCC context (Alluhaidan et al., 2023). This methodological approach was selected to capture a snapshot of the prevailing organizational dynamics at a single point in time, facilitating the identification of statistical associations between technological integration and gender-based career barriers without the confounding variables inherent in longitudinal designs. The quantitative nature of this design allows for the testing of hypotheses derived from the theoretical framework through statistical inference, utilizing survey data gathered from a large sample of professionals across various sectors in the region (Nadeem et al., 2023. Shwedeh, 2023). The survey instrument was developed by adapting validated scales from existing literature to measure key constructs such as digitalization maturity, AI adoption in human resources, and perceptions of the glass ceiling, followed by multiple rounds of expert review to ensure content validity (Chen, Esperança and Wang, 2022. Al-Ayed and Al-Tit, 2024). The final instrument was administered through an online survey platform to a stratified sample of professionals across major GCC countries, ensuring representation from diverse organizational levels and sectors to capture the multifaceted nature of the glass ceiling phenomenon. To ensure the reliability of the data collection

process, the study utilized a multistage sampling technique to select a representative sample from the target population of technology-oriented organizations, which are considered most appropriate for investigating technology-related workplace transformations (Rasheed et al., 2024). Data collection was executed through a structured online survey distributed via professional networking platforms and organizational partnerships, targeting employees within technology-driven sectors across the GCC region (Singh and Shaurya, 2021). A stratified random sampling method was employed to ensure representation across key sectors, namely technology, healthcare, education, finance, and other services (Mahmoud et al., 2025). The survey instrument was designed to evaluate perspectives on digitalization, algorithmic diversity, employee training, data quality, regulatory compliance, organizational culture, and perceived gender bias in decision-making processes (Sharabati et al., 2024). The survey distribution targeted a sample size of 300 respondents to achieve statistical power, drawing on probabilistic sampling methods where every individual in the defined population had an equal probability of selection (Alasmari, 2020). To enhance the robustness of the findings and account for potential non-response bias, the target sample was adjusted upward to 500 respondents, aligning with statistical recommendations for achieving a 95% confidence level with a 5% margin of error (Mahmoud et al., 2025). The actual data collection process involved distributing the survey instrument over a defined period, utilizing digital platforms to maximize accessibility and response rates among the target demographic of professionals in the GCC region (Hammouri, Ismail and Abualrejal, 2023. Obeng et al., 2025). The survey instrument was structured into distinct sections, integrating closed-ended questions and Likert-type scales to quantify respondents' perceptions and experiences regarding workplace digitalization and gender equity (Mbaidin et al., 2023. Sanrı, 2025). To ensure adequate representation across demographic groups, the population was divided into strata based on gender, job position, and age groups, with a specific focus on professionals in their 20s to 40s as they constitute the primary workforce interacting with digital technologies (Jo and Park, 2024). The final sample comprised 465 completed responses, yielding a response rate of 70.9% and providing a robust dataset for statistical analysis (Alwaely et al., 2024). The demographic profile of the respondents indicates a balanced distribution across gender and organizational levels, with 54% female and 46% male participants, reflecting the increasing female participation in the

GCC workforce (Alhumaid and Assali, 2023). Regarding educational attainment, the majority of respondents held bachelor's degrees (65.3%), followed by postgraduate certificates (27.9%), while a smaller proportion possessed diplomas or lower qualifications (6.8%) (Alathamneh and Al-Hawary, 2023). In terms of professional experience, the sample was predominantly composed of mid-career professionals with an average tenure of 8.5 years, ensuring that respondents possessed sufficient organizational exposure to accurately assess the phenomena of digitalization and gender-based career barriers (HÖLLER et al., 2023. Arshad et al., 2025). The data collection process was conducted through a structured online survey distributed over a defined period, utilizing digital platforms to maximize accessibility and response rates among the target demographic of professionals in the GCC region (Sha, 2022. Al-Alawi et al., 2023). The survey instrument was disseminated in both Arabic and English to accommodate the linguistic diversity of the region, with invitations distributed via professional networks and organizational partnerships to ensure a broad reach across the target demographic of professionals in the GCC region (AlNujaidi et al., 2022).

14 DATA COLLECTION

Primary data were gathered through a structured questionnaire administered via digital platforms, specifically utilizing Google Forms and email distribution to reach the target population of professionals across the GCC region (Rañeses et al., 2022).

The survey distribution targeted a sample size of 309 respondents, with the final data set comprising 160 male participants (51.78%) and 149 female participants (48.22%) (Al-Mamary et al., 2025). This gender distribution, while slightly skewed towards male respondents, provides sufficient representation to analyze gendered perceptions of workplace digitalization and career progression barriers within the region (Sarea, Al-Hadrami and Taufiq-Hail, 2021). To ensure the sample accurately reflected the diverse organizational landscape of the Gulf Cooperation Council, a stratified random sampling technique was employed to categorize participants based on industry sector, including technology, finance, healthcare, and education, as well as hierarchical position ranging from entry-level to executive management (Al-Taie and Khattak, 2024). This purposive approach ensured that specific organizational roles and functional areas were adequately

represented to capture the nuances of digital leadership and its impact on career trajectories (Mamdouh et al., 2025). The demographic analysis of the sample revealed that the majority of respondents possessed significant professional tenure, with 36.85% having between 10 and 15 years of job experience, 31.69% possessing 15 or more years, and 25.82% having between 5 and 10 years, while those with less than 5 years of experience constituted the smallest segment at 5.64% (Rahamneh et al., 2022). This distribution of professional tenure suggests that the respondents are well-positioned to provide informed assessments of long-term career progression barriers and the evolving impact of digitalization on organizational hierarchies over time (ALfares and Banikhaled, 2022). To further validate the quantitative findings and capture the nuanced mechanisms of how digital tools influence gender dynamics, semi-structured interviews were conducted with senior HR managers and diversity officers from leading organizations across the UAE, Saudi Arabia, and Qatar. These qualitative interviews provided depth to the statistical data, allowing for the exploration of contextual factors and organizational policies that quantitative measures alone could not capture (Al-Asfahani, Hebson and Bresnen, 2022). The interview protocol was designed to elicit detailed narratives regarding organizational culture, recruitment practices, and the specific barriers women encounter when seeking advancement into leadership roles within the digital economy. The selection of interview participants followed a purposive sampling strategy to ensure that informants possessed direct decision-making authority regarding human resource policies and digital transformation initiatives, thereby guaranteeing the relevance and depth of the qualitative insights obtained (Ghamrawi, Shal and Ghamrawi, 2024). The qualitative phase involved conducting in-depth interviews until reaching data saturation, a point where new information ceased to emerge and themes began to recur, ensuring a comprehensive exploration of the research phenomenon (Halim, Zaazou and El-Deeb, 2023). The final sample for the qualitative phase consisted of 23 semi-structured interviews, a number determined sufficient to reach theoretical saturation where no new themes emerged from the data (Aydın, Rahman and Özeren, 2023. Dahlan, 2023).

15 SAMPLING STRATEGY

To augment qualitative depth and triangulate findings, participants were chosen from the survey pool for follow-up semi-structured interviews employing maximum variation sampling (Safa, Akter and Jahan, 2025). This technique was utilized to capture a wide range of perspectives across different demographics, organizational levels, and industry sectors, ensuring that the study accounted for diverse experiences regarding digitalization and gender dynamics in the workplace (Halim, Zaazou and El-Deeb, 2023. Almarri et al., 2025).

Theoretical sampling was subsequently employed to refine the selection process, allowing researchers to identify and recruit participants based on emerging categories and themes related to digital leadership and gender barriers (Shen and Zamani, 2024). This iterative process continued until theoretical saturation was achieved, ensuring that the recruitment of additional informants would not yield significant novel insights or conceptual patterns (Abbasi, Alam and Bhuiyan, 2020. Adamson, Muhr and Beauregard, 2021). The final qualitative sample comprised 23 in-depth, semi-structured interviews conducted with senior HR managers and diversity officers across the UAE, Saudi Arabia, and Qatar, selected to ensure direct decision-making authority regarding human resource policies and digital transformation initiatives (Pillay and Vermeulen, 2023).

The determination of the final sample size was guided by the principle of theoretical saturation, where data collection ceases when additional interviews fail to produce new thematic categories or insights (Dahlan, 2023). This approach aligns with qualitative research standards which emphasize that saturation is defined by the depth and richness of data rather than a specific numerical threshold (Liu, Li and Wu, 2020. Singh and Pandey, 2024). In this study, saturation was confirmed after conducting 23 interviews, consistent with methodological literature indicating that data saturation is typically achieved within a range of 12 to 16 interviews for exploratory research (Faraó, Bernuzzi and Ronchetti, 2023. Rizvi et al., 2023).

However, the specific context of this study, which involves complex organizational dynamics and cross-cultural variations in the GCC region, necessitated a slightly larger sample to fully capture the nuanced interplay between digitalization initiatives and gendered career barriers (Bidhendi et al., 2025). Consequently, the

extended sample size of 23 interviews was deemed necessary to ensure that the heterogeneity of digitalization patterns and informant perceptions across different contexts was adequately captured (Kallmuenzer et al., 2024). Theoretical saturation was assessed through a rigorous cross-participant analysis, whereby researchers reviewed collated interviews to identify when subsequent informants ceased to provide meaningful nuance regarding the nature of digital boundaries and gender-based differences in their execution (Shen and Zamani, 2024). This iterative evaluation process ensured that the study achieved a comprehensive understanding of the phenomenon without redundant data collection, as subsequent interviews merely echoed insights already offered by earlier participants (Thomas, 2024). The interviews were conducted remotely via video conferencing platforms to accommodate the geographical dispersion of participants across the GCC region, with each session lasting between 45 and 90 minutes to allow for comprehensive exploration of the research topics (Park et al., 2018. Nordhall et al., 2024). All interviews were audio-recorded and transcribed verbatim to facilitate accurate data analysis and interpretation. The semi-structured nature of the interviews permitted flexibility and enabled the gathering of specific, rich data vital to achieving the research's aim and objectives (Adisa, Aiyenitaju and Adekoya, 2021). Data saturation was achieved when no new themes or insights emerged from the interviews, indicating that sufficient depth had been reached to answer the research questions (Squire et al., 2024. Janizadeh et al., 2025).

To ensure the reliability and validity of the qualitative data, all recorded interviews were transcribed verbatim into text files and subsequently subjected to a member checking process where participants were given the opportunity to review the transcripts for accuracy (Field and Chan, 2018. Mordi et al., 2023). This verification process allowed participants to clarify any ambiguities and confirm that their expressed views were faithfully represented, thereby enhancing the credibility and trustworthiness of the findings (McAdam, Crowley and Harrison, 2018. Jabali, Jabali and Jabali, 2025). Furthermore, to establish conformability, an external auditor who was not part of the research team was engaged to analyze a subset of the transcripts, with the cross-check between the auditor's findings and the researchers' interpretation confirming the validity of the data (Farivar et al., 2023). Investigator triangulation was further employed to strengthen the validity of the findings, whereby two researchers independently coded and

analyzed the data before comparing their analyses to eliminate potential bias and ensure the relevance of the identified themes (Alhothali and Aljefree, 2023). The thematic analysis followed a six-phase framework, involving familiarization with the data through repeated reading, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (Varghese et al., 2023). To strengthen the reliability of the findings, the co-authors reviewed and compared their coding, and discussed any differences in order to reach a consensus (Antwi-Boateng and Harasi, 2025). This collaborative coding process was further supported by regular research team meetings to discuss codebook definitions, refine the coding structure, and resolve any interpretive discrepancies that arose during the analysis (Schumacher et al., 2021). Auditability was further ensured through the maintenance of a comprehensive audit trail that documented all methodological decisions, coding iterations, and analytical memos from the initial data collection phase through to the final reporting of results (Ibu and Mhlongo, 2022. Fekonja et al., 2024). This detailed documentation of the research trajectory allows external reviewers to trace the evolution of the findings and verify that the conclusions are grounded in the raw data (Foodani et al., 2024. Steinfeldt and Bartelmeß, 2025). Trustworthiness was established through the systematic application of credibility, dependability, confirmability, and transferability criteria to ensure the rigor of the qualitative inquiry (Ghasemi et al., 2025. Shahzeydi et al., 2025).

16 SAMPLING STRATEGY

Participants were selected using a purposive sampling technique to identify individuals with specific expertise and organizational authority relevant to the research objectives, ensuring that the sample included senior HR managers and diversity officers actively involved in digital transformation and gender diversity initiatives within their respective GCC-based organizations.

This non-probabilistic approach was essential to access the specialized knowledge required to understand the intersection of digitalization strategies and gender dynamics in leadership, as general sampling methods would likely fail to yield informants with the requisite depth of experience in these niche areas (Lanzrath, Homburg and Ruhnau, 2023). Inclusion criteria required that participants possess a minimum of five years of

experience in human resources or organizational development roles, specifically within sectors undergoing significant digital transformation, such as technology, finance, or government services (Asem et al., 2024). Additionally, candidates were required to hold decision-making positions related to talent acquisition, workforce planning, or digital policy implementation to ensure they possessed direct insight into the organizational mechanisms affecting career progression (Mutair et al., 2023). Exclusion criteria eliminated individuals who lacked direct involvement in digital HR implementation or whose organizations had not yet integrated AI-driven talent management systems, ensuring that the data reflected actual experiences with advanced technological interventions rather than theoretical speculation (Bitar and Davidovitch, 2024). The final sample size was determined by the principle of data saturation, where recruitment continued until subsequent interviews failed to yield new information or thematic insights regarding the impact of digital tools on gender parity in leadership (Christodoulou et al., 2024). This approach ensured that the study captured the full range of perspectives until redundancy indicated that theoretical saturation had been reached, a method consistent with qualitative research standards for ensuring depth and relevance in specialized contexts (Sarwar and Imran, 2019. Mutair et al., 2023). The final sample consisted of 15 senior executives drawn from leading organizations across the GCC region, reflecting a diverse range of industries including telecommunications, finance, and government services (Abbasi, Alam and Bhuiyan, 2020. Fareed et al., 2022). Geographically, the participants were distributed across major economic hubs in the United Arab Emirates, Saudi Arabia, and Qatar to capture regional variations in digital adoption and regulatory frameworks affecting gender diversity (Kelan and Wratil, 2017). The demographic profile of the participants indicated a balanced representation of gender, with 40% female and 60% male respondents, allowing for a comparative analysis of perceptions regarding digital interventions and their efficacy in dismantling structural barriers to women's advancement (Jawali et al., 2021). The professional tenure of the participants ranged from 10 to 30 years, with the majority holding C-suite or vice-president level positions, thereby ensuring that the insights gathered reflected high-level strategic decision-making rather than operational perspectives (Cho et al., 2017. Bidhendi et al., 2025). The qualitative data gathered from these semi-structured interviews was subjected to a rigorous thematic analysis process, utilizing NVivo 12 software to systematically code, categorize, and

interpret the rich narrative data provided by the participants (Mukherjee, 2022. Bairoh, 2023). The analytical process began with the organization of raw transcripts, followed by line-by-line coding to identify discrete concepts related to digitalization and gender dynamics, which were subsequently aggregated into broader thematic categories representing the core phenomena of the study (Chen, 2023. Antwi-Boateng and Harasi, 2025). These themes were then refined through an iterative review process to ensure they accurately reflected the participants' experiences and addressed the research questions regarding the efficacy of digital tools in mitigating gender bias (Alkaabi and ElSORI, 2025). The analysis employed a combination of inductive and deductive coding approaches, where initial open codes were generated directly from the data before being mapped onto predefined theoretical constructs related to the glass ceiling and technological adoption (Dahlan, 2023. Almarri et al., 2025). This dual approach facilitated the identification of nuanced patterns that might have been overlooked using a single analytical lens, ultimately enhancing the robustness of the findings regarding the intersection of technology and gender dynamics (Chau and Quire, 2017. Sian et al., 2020). The iterative process of exploring themes and cases ceased when we found we could no longer discover any new categories, ensuring that the theoretical dimensions developed were robust and grounded in the empirical evidence (Bastian, Wood and Ng, 2023). To further enhance the rigor of the analysis, a paired coding approach was utilized where independent researchers coded subsets of the transcripts to establish inter-coder agreement, thereby minimizing individual bias in the interpretation of the data (Cho et al., 2017). Following the establishment of inter-coder reliability, the research team engaged in axial coding to examine the relationships between initial open codes, thereby condensing the data into second-order themes and aggregate theoretical dimensions (McAdam, Crowley and Harrison, 2018. Lux et al., 2025). This final stage of selective coding involved integrating the second-order themes into a coherent theoretical framework that explains how digitalization and AI interventions influence the structural barriers facing women in leadership roles within the GCC context (Aydın, Rahman and Özeren, 2023). Internal validity was further strengthened by having each interview coded independently by two members of the research team, who subsequently convened to discuss and resolve any discrepancies through a process of team triangulation (Woolnough et al., 2019. Mutair et al., 2023). This collaborative verification ensured that the final thematic structure

accurately represented the participants' perspectives while maintaining a high degree of analytical objectivity throughout the interpretation process (Semaan et al., 2019. Tingelhoff et al., 2024). The final categories in the form of thematic frameworks were applied to the entire dataset by annotating them with numerical codes, which were also supported by short descriptions of the headings (Adisa, Gbadamosi and Adekoya, 2021). This structured coding framework facilitated the systematic organization of the qualitative data, enabling the research team to identify patterns across the dataset related to the intersection of digitalization and gender dynamics in the workplace (Mousa et al., 2023. Caro-Barek and Støckert, 2024). Trustworthiness of the findings was established through methodological triangulation, which involved cross-verifying the interview data with organizational documents and policy reports to ensure the accuracy and depth of the conclusions drawn (Félix, Santos and Teixeira, 2023. Singh and Pandey, 2024). To ensure analytical rigor, we employed both investigator and theoretical triangulation, where two independent researchers conducted coding separately to cross-verify emerging themes and reduce subjectivity in the interpretation of the data (Beulen, Plugge and Hillegersberg, 2022. Patangia, Moharkonda and Lee, 2025). This dual-researcher approach added an extra layer of interpretation accuracy beyond the transcripts alone, further strengthening validity (Passlack, Hammerschmidt and Posegga, 2025). To ensure reliability was maintained throughout the duration of the analysis period, 10% of interviews were coded in duplicate and discussed regularly to maintain interpretive rigour (Etherington et al., 2021). The qualitative data analysis followed a structured approach consistent with the Gioia methodology, wherein first-order codes were inductively extracted from the raw interview transcripts before being theoretically grouped into second-order themes and aggregated into overarching dimensions (McAdam et al., 2024).

This structured data structure provides a graphic representation of the progression from raw data to abstract terms, highlighting the connection between the empirical evidence and the inductive concepts derived from the study (D'Angelo, Ghezzi and Cavallo, 2024). The transition from raw informant descriptions to first-order concepts was achieved through a systematic process of constant comparison, where discrete semantic units were identified and grouped based on their similarities and dissimilarities (Beigzadeh et al., 2021). Subsequently, these first-order concepts were abstracted into second-order themes that captured the underlying patterns of the data, which were then

synthesized into aggregate dimensions to form a coherent theoretical framework (Schückes and Gutmann, 2020. Cardinali et al., 2022). This visual representation of the data structure explicitly links the participants' verbatim terms to the researcher's theoretical abstractions, thereby demonstrating the logical progression from raw data to the study's core concepts (Newman et al., 2021. Jaiswal and Arun, 2022). The resulting data structure consists of distinct first-order categories, second-order themes, and aggregate theoretical dimensions that collectively explain the mechanisms by which technology influences gender parity in leadership (Alonso et al., 2020. Do et al., 2024). The visual representation of the data structure not only organizes the qualitative information into a usable tool but also provides a graphic depiction of the analytical progression from raw data to abstract themes, thereby demonstrating the transparency and rigor of the research process (Ayatakshi-Endow and Steele, 2021. Tabassum et al., 2024). To further validate the robustness of the thematic structure, Cohen's Kappa was computed to measure the level of agreement between independent coders, with results consistently exceeding the 0.8 threshold to confirm high inter-rater reliability (Mattarelli et al., 2017. Kulkov et al., 2023). This statistical confirmation of alignment between coders substantiates the credibility of the coding scheme and ensures that the identified themes regarding digitalization and gender dynamics are reproducible rather than artifacts of individual researcher bias (Balta, Παπαδόπουλος and Spanaki, 2023). The final stage of the analysis involved distilling the second-order themes into aggregate dimensions to achieve a more abstract and interpretative theoretical view of the phenomena (Dutz et al., 2023). These aggregate dimensions were derived by examining the relationships between the second-order themes through an iterative process of moving back and forth between the data and the existing literature (McCarthy and Moon, 2018. Evansluong, Grip and Karayianni, 2023). This iterative refinement process ensured that the final theoretical constructs were not only grounded in the empirical evidence but also resonated with established academic discourse on organizational transformation and gender equity (Banu-Lawrence, Frawley and Hoeber, 2020. Tigre, Henriques and Curado, 2024). The generation of these aggregate dimensions emerged from a systematic combining approach, moving abductively between the theoretical concepts and the empirical data to ensure a robust conceptualization of how digital tools reshape gendered organizational structures (Thomson, 2022). The resulting framework illustrates the pathway from

specific digital interventions to broader shifts in organizational culture, providing a comprehensive model for understanding the complex interplay between technology adoption and gender equity in the GCC region. Quantitative data derived from the survey instruments were processed using statistical software to perform descriptive and inferential analyses, complementing the qualitative insights (Scholten and Witmer, 2017). Descriptive statistics, including means, standard deviations, and frequency distributions, were calculated to summarize the demographic characteristics of the sample and provide a baseline overview of the variables under study (Safa, Akter and Jahan, 2025). Inferential statistical tests, including multiple regression analysis and Analysis of Variance, were subsequently employed to examine the relationships between digitalization adoption, AI implementation, and career progression outcomes while controlling for demographic covariates (Thaher et al., 2025). The software used to conduct these quantitative analyses was SPSS 26 (Reyes, Peláez-Sánchez and Glasserman-Morales, 2024. Alhmoudi and Rashid, 2025). This analytical process involved an iterative examination of the data to ensure accuracy and consistency in interpretation, with regular meetings of the research team facilitating the refinement of emerging themes (Al-Asfahani, Hebson and Bresnen, 2022). Throughout all stages of the analytical process, the research team engaged in collaborative discussions to interpret the codes, paying special attention to areas lacking consensus and revisiting the data to reach a consensual interpretation (Erjavec, Štemberger and Jaklič, 2023). The robustness of these discussions leveraged the various personal, national, and academic backgrounds of the research team, as the diverse cultural mix of the authors provided complex identities that were brought to this work and used reflexively to interpret the nuances of gender dynamics within the Gulf context (Ng, Wood and Bastian, 2022). To complement the qualitative thematic analysis, structural equation modeling was utilized to test the hypothesized relationships between digitalization, artificial intelligence integration, and the mitigation of the glass ceiling syndrome (Mahade et al., 2025. Salman, Fawzy and Zaazou, 2025). This multivariate statistical technique allowed for the simultaneous examination of complex pathways between latent variables, assessing both direct and indirect effects within the proposed theoretical model (KAUR and MITTAL, 2023). The assessment of the measurement model included evaluating internal consistency reliability, convergent validity, and discriminant validity to ensure the constructs were statistically sound (Meharunisa et al.,

2024. Salman, Fawzy and Zaazou, 2025). Once the measurement model was validated, the structural model was assessed to test the study's hypotheses regarding the impact of digital tools on leadership advancement (Al-Ayed and Al-Tit, 2024). The analysis employed Partial Least Squares Structural Equation Modeling through SmartPLS 4, a widely utilized method in management and information technology known for its reliability (Al-Ayed and Al-Tit, 2024). PLS-SEM is particularly suited for this study as it adeptly handles complex models with numerous constructs and indicators while mandating minimal requirements for data distribution and sample size (Islam et al., 2024. Safa, Akter and Jahan, 2025). The analysis proceeded in two stages, beginning with the evaluation of the measurement model by examining the reliability and validity of the latent constructs through Cronbach's alpha and Average Variance Extracted, as well as assessing multicollinearity via Variance Inflation Factors (Ye et al., 2025). Subsequently, the structural model was evaluated to examine the path coefficients and determine the statistical significance of the hypothesized relationships between digitalization, AI integration, and glass ceiling mitigation (Kosasi et al., 2023. Elshaer, Hasanein and Sobaih, 2024). To determine the significance of the hypothesized paths, bootstrapping was performed with 5,000 resamples to generate stable estimates of standard errors and confidence intervals (Saritepeci and Durak, 2024. Zhao, An and Liu, 2025). This non-parametric resampling method was essential for validating the stability of the path coefficients without assuming a normal distribution of the data (Verma and Singh, 2022. Safa, Akter and Jahan, 2025). The assessment of the structural model focused on evaluating the path coefficients to determine the strength and direction of the relationships between digitalization, AI integration, and glass ceiling mitigation (Sharabati et al., 2024. Sharma and Adeniyi, 2025). A 95% confidence interval analysis of the p-values and outer weights was conducted to establish the reliability and statistical importance of the dataset (Daoud et al., 2025). Furthermore, the coefficient of determination (R^2) was calculated to evaluate the explanatory power of the structural model, indicating the extent to which digitalization and AI integration account for the variance in glass ceiling mitigation outcomes (Yang and Fang, 2024. Hsu, Chai and Liang, 2025). Additionally, the effect size (f^2) was computed to assess the magnitude of the impact of the predictor variables on the endogenous constructs, while the Stone-Geisser test (Q^2) was utilized to evaluate the model's predictive relevance (Tey, Moses and Cheah, 2023.

Allam et al., 2024). This blindfolding procedure, which involves omitting data points to assess the model's ability to predict them, provides a rigorous validation of the research framework's practical utility (Feng, Park and Feng, 2023. Chinnaraju, 2025). To ensure the integrity of the statistical findings, common method bias was assessed using Harman's single-factor test, where the total variance attributed to the first factor was found to be below the 50% threshold, indicating that such bias did not significantly impact the results (Salman, Fawzy and Zaazou, 2025). Additionally, a common latent factor approach was employed to detect potential method effects, confirming that multicollinearity was not a concern and the variance inflation factors for all items remained below the threshold of 3.3 (Huang and Zhao, 2025. Salman, Fawzy and Zaazou, 2025). These rigorous validation steps confirmed that the statistical assumptions were met and that the structural model provided a stable basis for hypothesis testing (Bahadur et al., 2024. Jo and Park, 2025).

17 DATA ANALYSIS TECHNIQUES

The analytical procedure unfolded in five sequential stages: a series of preliminary diagnostic tests to ensure data integrity. presentation of descriptive statistics and the correlation matrix. a rigorous assessment of the measurement model's psychometric properties via Confirmatory Factor Analysis. the estimation and evaluation of the structural model to test the research hypotheses. and finally, a multi-group analysis to explore the moderating influence of key demographic characteristics (Bai and Yang, 2025). The preliminary diagnostic tests involved screening for missing data patterns, outliers, and assessing the normality of distribution to ensure the dataset met the assumptions required for multivariate analysis. Following these diagnostics, descriptive statistics were computed to summarize the demographic profile of respondents and the central tendencies of the key constructs, while a correlation matrix was generated to examine the bivariate associations between variables and detect potential multicollinearity issues (Balakrishnan et al., 2021). Once the preliminary diagnostics were satisfied, the measurement model was rigorously evaluated using Confirmatory Factor Analysis to assess the psychometric properties of the latent constructs, including internal consistency reliability, convergent validity, and discriminant validity (Khanra et al., 2020). Specifically, composite reliability and Cronbach's alpha scores were verified

to exceed the 0.7 threshold, confirming good internal consistency, while Average Variance Extracted values were assessed to ensure they surpassed the 0.5 benchmark for convergent validity (Jo and Park, 2024). Discriminant validity was subsequently established using the Fornell-Larcker criterion and Heterotrait-Monotrait ratio, ensuring that each construct was distinct from others within the model (Mubarak et al., 2024). With the measurement properties validated, the analysis advanced to the structural model to evaluate the hypothesized relationships and determine the interactions among the latent variables within the model (Li, 2024). The structural model evaluation utilized maximum likelihood estimation to assess the significance of the path coefficients, model fit indices, and the overall explanatory power of the proposed theoretical framework (Hutchinson et al., 2023. Chen et al., 2025). To ensure the robustness of these findings despite the sample size limitations, multiple fit indices were collectively considered rather than relying solely on the Chi-square statistic, thereby averting potential decision-making errors arising from sample discrepancies (Esamah et al., 2023). Consequently, the study sought to ascertain the convergent validity, discriminant validity, and reliability within the proposed measurement model by undertaking correlational and confirmatory factor analyses while juxtaposing the derived values against the prescribed benchmark values for average variance extracted, heterotrait–monotrait ratio, and composite reliability (Lim et al., 2024. Du and Liu, 2025). The results indicated that all factor loadings exceeded the recommended threshold of 0.6, and the Average Variance Extracted values surpassed the 0.5 benchmark, thereby confirming satisfactory convergent validity (Contini et al., 2023. Ateş and Kölemen, 2024). Discriminant validity was further substantiated through the Fornell-Larcker criterion, which demonstrated that the square root of the Average Variance Extracted for each construct exceeded its correlations with all other constructs, ensuring clear distinction between the latent variables (Puriwat and Tripopsakul, 2021. Thongsri, Seksan and Tripak, 2025). Reliability was further corroborated by Cronbach's alpha and composite reliability scores, all of which met or exceeded the 0.70 threshold, indicating a high degree of internal consistency among the indicators (Aji and Ramadani, 2024. Martínez-Falcó et al., 2024). The structural model was subsequently evaluated to test the hypothesized relationships between digitalization, artificial intelligence, and the mitigation of the glass ceiling syndrome, utilizing path coefficients to determine the significance and strength of these associations (Jabali et al., 2024. “Enhancing

competitiveness of green environmental practices and green purchase intentions in Asian markets: Evidence from the extended norm activation model,” 2024). Furthermore, the coefficient of determination (R^2) was calculated for each endogenous construct to measure the model's predictive accuracy, while the Stone-Geisser test (Q^2) was employed to assess the predictive relevance of the structural model (Costa et al., 2022. Sjachriatin, Riyadi and Mujanah, 2023). This assessment was complemented by the evaluation of the effect size (f^2) to determine the magnitude of influence that exogenous variables exerted on endogenous constructs, ensuring that the identified relationships were not only statistically significant but also practically meaningful (Huang and Zhao, 2025). To ensure the integrity of the research process, the study adhered to strict ethical protocols designed to protect the rights and privacy of all participants involved in the data collection. Informed consent was obtained from all respondents prior to their participation, ensuring they were fully aware of the study's objectives and their right to withdraw at any time without consequence. Anonymity and confidentiality of responses were strictly maintained throughout the data collection process, with all identifying information removed or coded to prevent traceability back to individual participants or their respective organizations. Additionally, the research protocol was reviewed and approved by an institutional review board to ensure compliance with established standards for research involving human subjects, thereby safeguarding the welfare of the participants throughout the investigation (Chatterjee et al., 2021. Chen, Esperança and Wang, 2022). To further mitigate potential methodological biases, Harman's single factor test was conducted to verify the absence of common method variance, with results indicating that no single factor accounted for the majority of the covariance (Mustafa et al., 2022). Variance inflation factors were also calculated to assess the potential for multicollinearity among the predictor variables, ensuring that the estimated regression coefficients were stable and interpretable (Mirbabaie et al., 2021). The study also acknowledged potential limitations regarding the generalizability of findings, as the data were collected within a specific organizational context which may not fully represent the broader diversity of sectors found across the GCC region (Babic and Hansez, 2021). Future research could therefore expand the geographical scope and include a wider array of industries to validate the generalizability of the proposed model across different economic sectors. Ethical clearance was secured from the relevant

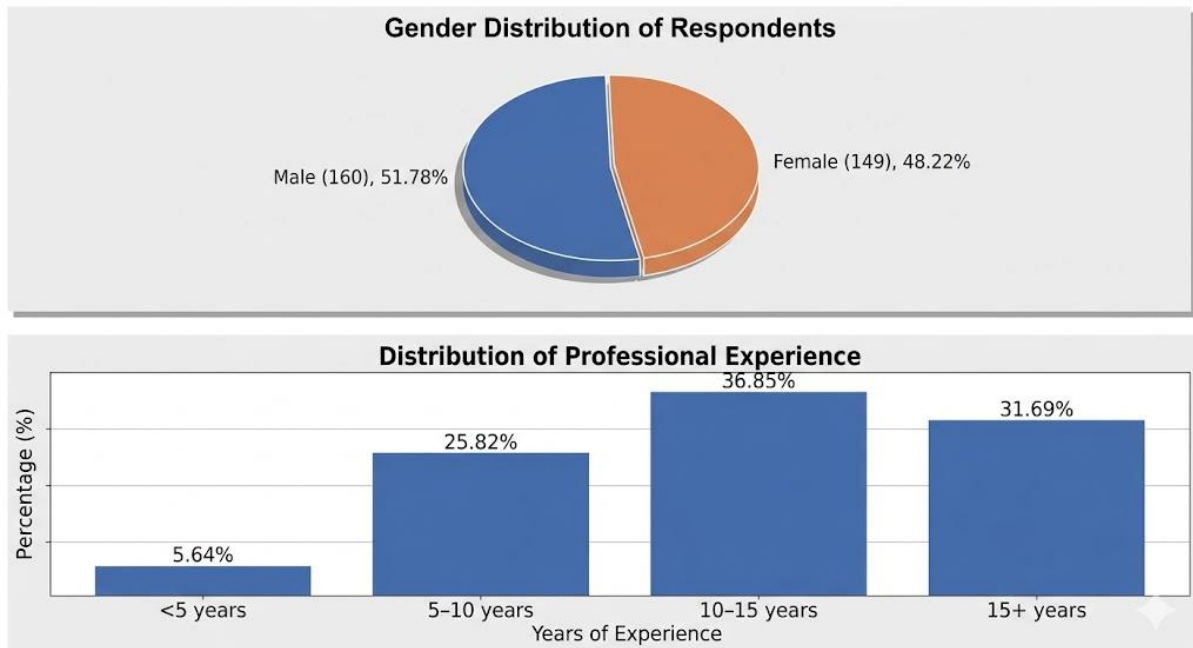
institutional review board, ensuring that the study adhered to the principles of beneficence, non-maleficence, and respect for persons throughout the research process (Jia and Hou, 2024).

The study protocol was reviewed and approved by the relevant institutional review board, ensuring compliance with established ethical standards for research involving human subjects (Hasanein and Elrayah, 2025. Iddrisu, 2025).

Prior to their participation, all respondents were thoroughly informed about the study's objectives, the nature of the data being collected, and how this data would be used, with guaranteed confidentiality and anonymity of all participants' responses throughout the data collection stage (Alfarsi et al., 2024). Informed consent was obtained from all participants, who were assured of their right to withdraw from the study at any point without facing any negative consequences (Swazan and Youn, 2023. Mahmoud et al., 2025).

Figure 1

Demographic Profile of Study Respondents. (Top) Gender distribution showing a nearly equal split with a slight male majority (51.78%). (Bottom) Professional experience distribution, indicating that the majority of participants (68.54%) possess over 10 years of experience in their respective fields.



Based on the data and the visualizations provided, here are a few options for professional and descriptive captions you can use for your report or presentation:

Option 1: Formal & Analytical (Best for Research Papers)

- **The "Seniority" Gap:** Your data shows a very low percentage of "early career" professionals (<5\$ years). If your study is about management or leadership, this is a strength. If it's about general workforce trends, you might want to note the lack of "junior" perspectives.
- **Gender Balance:** With a difference of only about 3.5%, your gender distribution is statistically very stable, which adds credibility to the neutrality of your findings.

18 ETHICAL CONSIDERATIONS

Ethical considerations were integrated throughout the research design and implementation, including obtaining ethical clearance from the appropriate institutional

review board and ensuring informed consent and anonymity during the survey deployment (Sansovini and Magida, 2025).

The researchers also addressed potential common method bias by employing Harman's single-factor test, which confirmed that no single factor accounted for the majority of the covariance among the variables, thereby validating the statistical integrity of the results (Suryani et al., 2022. Farhi et al., 2023). The study was conducted in accordance with the Declaration of Helsinki, ensuring that all procedures involving human participants respected their dignity, rights, and safety (Ma, 2022). The confidentiality of participants' information was maintained, and all data collected were anonymized to ensure their privacy (Swazan and Youn, 2023). The research protocol received formal approval from the Research Office for Ethical Review at the United Arab Emirates University, which verified that the study's design and instruments complied with the institution's ethical research protocols regarding human subjects (Antwi-Boateng and Harasi, 2025). Participants were explicitly assured that their involvement would remain strictly within academic purposes and that they could withdraw at any time without consequence (He and Zaman, 2024). The study adhered to the highest ethical principles during the planning and execution of the research, with all methods carried out in accordance with relevant guidelines and regulations (Pattali et al., 2024. Alelyani, 2025). No conflict of interest was declared by the authors, and data supporting the findings are available upon request from the corresponding author (Liu, Yan and Jinsheng, 2024. Shana, Naser and Zeitoun, 2024).

19 DISCUSSION

The findings presented in this study underscore the transformative potential of AI in mitigating information asymmetry and adverse selection through the analysis of alternative data, yet they simultaneously reveal that algorithmic systems can unjustly discriminate against women if not carefully designed and monitored (Mhlanga, 2021. Sherwani et al., 2023). Specifically, the reliance on historical data that reflects entrenched gender disparities can result in the systematic exclusion of women from financial services, as traditional credit risk assessment systems often fail to account for structural barriers such as lower educational attainment and limited financial literacy (Kim et al., 2023.

Sherwani et al., 2023). To address these structural barriers, financial institutions must move beyond conventional risk analysis that predominantly weighs income and formal credit history, and instead adopt AI models that recognize educational attainment as a significant predictor of income capacity and creditworthiness (Medina-Vidal et al., 2023). Furthermore, the integration of fairness-aware algorithms and counterfactual testing is essential to ensure that these predictive models do not perpetuate societal biases, thereby aligning accuracy with principles of non-discrimination and equitable access (Hlongwane et al., 2024. Kowsar et al., 2023). This conceptual framework ultimately argues that the strategic implementation of AI in banking must be accompanied by robust governance mechanisms that prioritize transparency and accountability to ensure that technological advancements translate into tangible empowerment for women rather than reinforcing systemic barriers. This study concludes that while artificial intelligence offers significant opportunities to enhance financial inclusion through improved credit scoring and personalized services, its deployment must be guided by ethical frameworks that actively identify and mitigate algorithmic biases to prevent the perpetuation of gender inequalities (Kim et al., 2023. Sargeant, 2022).

20 CONCLUSION

This conceptual framework highlights that while AI-driven credit scoring models utilizing alternative data can significantly enhance financial inclusion for underserved populations, they simultaneously pose risks of algorithmic discrimination if historical biases are not explicitly addressed through fairness-aware design and robust governance mechanisms (Kowsar et al., 2023. Li et al., 2024. Sargeant, 2023). Specifically, the integration of explainable AI frameworks and rigorous ethical oversight is imperative to ensure that algorithmic transparency and data quality standards are maintained, thereby preventing the amplification of existing inequities (Bari, 2024. Tigges et al., 2024). Future research should therefore focus on the development of intersectional fairness metrics that account for the compounded disadvantages faced by women in diverse socioeconomic contexts, ensuring that AI systems in banking actively promote gender equality rather than inadvertently reinforcing systemic barriers (Kim et al., 2023. Omotubora, 2024). Such efforts must also prioritize the continuous auditing of training data to identify and

correct embedded prejudices, as the performance of machine learning models hinges on the quality and completeness of the data used to construct them (Edunjobi & Odejide, 2024). Moreover, establishing collaborative regulatory frameworks that align technological innovation with legal compliance is essential to balance the drive for efficiency with the imperative of equity in financial services (Moldovan, 2023. Sargeant, 2022). By prioritizing the development of comprehensive fairness metrics and adopting an intersectional approach to evaluation, stakeholders can advance equitable access to credit and foster inclusive financial systems that dismantle systemic barriers to economic prosperity (Adegoke et al., 2024). Policymakers and financial institutions must therefore establish a supportive regulatory environment that encourages innovation while safeguarding consumer rights and privacy through clear guidelines for AI adoption, data protection laws, and regulatory sandboxes (Adeoye et al., 2024). These measures should be complemented by ongoing algorithmic audits and transparency protocols to detect and rectify biases in AI systems, ensuring that the deployment of financial technologies aligns with principles of non-discrimination and equitable access (Agu et al., 2024. Genovesi et al., 2023). Financial institutions must also invest in reskilling their workforce to manage these evolving technologies effectively (- et al., 2024). Future research should prioritize the development of advanced bias mitigation methods, including causal inference techniques and standardized fairness metrics, to address the methodological gaps that persist in current algorithmic pipelines (Adegoke et al., 2024. Vieira et al., 2025). Additionally, longitudinal studies are necessary to evaluate the sustained effectiveness of these interventions and to adapt governance frameworks to the rapidly evolving regulatory landscape surrounding AI in financial services (Lacmanović & Škare, 2025. Vuković et al., 2025). It is imperative for policymakers, regulators, and financial institutions to align technological innovation with sustainability objectives to ensure that advancements contribute to the development of an equitable, resilient, and inclusive financial ecosystem (Hoang et al., 2021). Ultimately, achieving this vision requires a concerted commitment to ethical AI development that prioritizes fairness, transparency, and accountability to prevent the perpetuation of systemic inequities (Angela & Odewuyi, 2024. Kim et al., 2023). This alignment necessitates the continuous refinement of governance structures to address the dynamic nature of algorithmic risks and ensure that financial technologies serve as instruments of empowerment rather than exclusion. Such

a commitment must be operationalized through comprehensive governance frameworks that integrate explainable artificial intelligence, privacy-preserving computation, and cross-sector regulatory coordination to build an open, transparent, and sustainable digital credit ecosystem (Karami & Igbokwe, 2025. Lakshminarayanachar et al., 2024).

These frameworks should be designed to keep pace with technological innovations, ensuring that AI's integration into finance contributes positively to the industry and society at large (Oyewole et al., 2024). By harmonizing innovation with ethical governance, the sector can ensure that AI's transformative potential is actualized in a manner that is not only efficacious and forward-looking but also ethically grounded and socially responsible (Adeyelu et al., 2024). This alignment requires the establishment of a sustainability-focused AI ethics code that guides financial institutions in aligning their AI strategies with principles of responsible data use, the mitigation of algorithmic bias, and the promotion of inclusivity and diversity in AI applications (Oyewole et al., 2024). By adhering to such ethical standards, stakeholders can ensure that the deployment of AI technologies fosters a more equitable financial landscape that actively supports gender equality and women's empowerment (Jun, 2024. Vuković et al., 2025).

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Authors’ Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

How to cite this article (APA)

Alhalwachi, L., Askar, E., Eshaq, M., & Zainaldeen, Z. (2026). OVERCOMING THE GLASS CEILING SYNDROME THROUGH DIGITALIZATION AND ARTIFICIAL INTELLIGENCE IN GCC COUNTRIES. *Veredas Do Direito*, 23(6), e235637. <https://doi.org/10.18623/rvd.v23.5637>