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RESILIENT HR SYSTEMS IN THE FACE OF CLIMATE AND AI DISRUPTION: EXAMINING WORKFORCE SUSTAINABILITY IN A CHANGING ENVIRONMENT

DR SHAIKHAH ALAINATI
Management Department, College of Business Studies
Public Authority for Education and Training, Kuwait
Email: sj.alainati@paaet.edu.kw
ORCID: 0000-0003-0955-0124

DR ANFAL ALBADIR
Management Department, College of Business Studies
Public Authority for Education and Training, Kuwait
Email: af.albader@paaet.edu.kw
ORCID: 0009-0005-4144-5887

DR MARIAM A. ALTERKAIT
Management Department, College of Business Studies
Public Authority for Education and Training, Kuwait
Email: ma.alterkait@paaet.edu.kw
ORCID: 0000-0002-6557-8247

PROFESSOR AHMED AL-HUNAIYYAN
Computing Department, College of Business Studies, Public Authority for Education and Training, Kuwait.
Email: aa.alhunaiyyan@paaet.edu.kw
ORCID: 0000-0002-1393-7260

DR ANWAAR ALKANDARI
Business Management School, Kuwait Technical College, Kuwait
Email: a.alkandari@ktech.edu.kw
ORCID: 0000-0003-1996-0768

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ABSTRACT

PURPOSE: This study investigates the interrelated impacts of environmental pressure and artificial intelligence (AI) integration on workforce sustainability and organisational adaptability.

DESIGN/METHODOLOGY/APPROACH: A cross-sectional survey of 272 Human Resources (HR) professionals and leaders in Kuwait was conducted, and structural equation modelling (SEM) in JAMOVI was used to test direct and mediating effects among the constructs.

FINDINGS: AI integration ($\beta = 0.492$, $p < 0.001$) and environmental pressure ($\beta = 0.265$, $p < 0.001$) significantly influenced organisational adaptability. Workforce sustainability strongly mediated these relationships.

ORIGINALITY/VALUE: This study contributes novel insights on dual disruption adaptation in HR systems within Gulf contexts, offering an empirically validated resilience framework.

RESEARCH LIMITATIONS AND IMPLICATIONS: The study's limitations include its geographic specificity and cross-sectional design. Future research may adopt longitudinal or comparative models across industries.

PRACTICAL IMPLICATIONS: The findings inform HR practices involving digital upskilling, AI trust-building and environmentally responsible recruitment to bolster workforce resilience.

KEYWORDS: *AI Integration; Environmental Pressure; Workforce Sustainability; Organisational Adaptability; Structural Equation Modelling; Kuwait.*

INTRODUCTION

In an era of escalating environmental disruption and accelerated technological advancement, the resilience of human resource (HR) systems has become a foundational element of organisational sustainability. Climate change and artificial intelligence (AI) represent two converging forces transforming workforce composition, employment models, and operational paradigms on a global scale. AI continues to redefine job structures through automation and intelligent systems, as HR systems increasingly leverage these technologies to enhance operational efficiency (Al-Ayed, 2024). Simultaneously, climate-induced socio-economic shifts necessitate a realignment of organisational strategies, including workforce reskilling and eco-conscious policy design, as companies adapt to changing environmental conditions and seek sustainable practices (Akter, 2024).

In response to this dual disruption, the notion of workforce sustainability, defined as the long-term adaptability, productivity, and well-being of employees, has gained significant attention (AlReshaid *et al.*, 2025). Achieving workforce sustainability in the face of AI and environmental pressure requires more than conventional HR practices; it calls for resilient systems that prioritise digital upskilling, sustainable recruitment, and proactive workforce planning (Alkandari *et al.*, 2023; Al-Kenane *et al.*, 2025).

When integrated effectively into HR processes, AI can enhance decision-making, enable performance tracking, and optimise resource deployment (Pandey, 2024). However, such integration is not without risks. Concerns surrounding job displacement, digital divide, and ethical implications challenge organisations to develop inclusive,

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human-centred strategies (Bartenschlager *et al.*, 2023; Chenais *et al.*, 2023). Meanwhile, environmental imperatives, such as regulatory mandates, stakeholder activism, and the shift to green economies, require the cultivation of environmentally literate, adaptable employees (Woo and Kang, 2021).

These dynamics underscore the increasing relevance of organisational adaptability, the capability to recalibrate structures, processes, and cultures in response to external pressures. Although AI and environmental change have been studied independently, limited empirical research has examined their combined impact on workforce sustainability and adaptability. Moreover, few studies have employed quantitative modelling to assess the mediating role of workforce sustainability in this context.

To address this gap, the current study applies a structural equation modelling (SEM) approach to investigate the inter-relationships between environmental pressure, AI integration, workforce sustainability, and organisational adaptability. Using survey data from HR professionals and organisational leaders, the research aims to validate a multi-construct framework that explains how dual external pressures shape internal workforce resilience and strategic agility.

By situating this inquiry at the intersection of digital transformation, sustainability, and HR resilience, the study offers theoretical advancement and practical insights for organisations seeking to future-proof their human capital strategies.

THEORETICAL FRAMEWORK AND DEFINITIONS

Environmental Pressure

Environmental pressure, encompassing ecological regulations, consumer expectations, and global sustainability goals, has increasingly influenced the adoption of green human resource practices. Nguyet (2025) highlights its dual role as both a motivator and a constraint in driving workforce sustainability, while Munziar and Hodijah (2025) suggest that organisations subjected to ecological scrutiny often embed resilience and sustainability within their HR policies. Furthermore, external mandates become effective only when aligned with internal cultural values (AlHussainan *et al.*, 2022).

AI Integration

The integration of artificial intelligence (AI) technologies into HR processes can enhance workforce sustainability by enabling smarter recruitment, efficient performance tracking, and informed workforce planning. The combination of AI and green human resource management

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(HRM) supports sustainable workplace environments, as AI helps organisations track sustainability metrics that align human resource practices with environmental goals (Najam Shaikh *et al.*, 2025; Masood *et al.*, 2024; Pandey, 2024). AI-enabled green recruitment processes can optimise the selection of candidates whose values align with sustainability principles, fostering a commitment to sustainable practices within the workforce (Najam Shaikh *et al.*, 2025).

Research indicates that employee trust in AI is associated with higher morale and retention, key elements of workforce sustainability (Sova *et al.*, 2023; Böhmer and Schinnenburg, 2023). High trust levels can lead to more engaged employees who are willing to adapt to new technologies, enhancing organisational commitment and performance (Al-Ayed, 2025; Jangbahadur *et al.*, 2025).

Workforce Sustainability

Organisations that prioritise workforce sustainability through continuous learning, employee well-being, and participatory leadership are better positioned to respond to dynamic external environments. While empirical evidence directly linking workforce sustainability to organisational agility remains limited across sectors, emerging studies offer relevant insights. For example, Owen-Boukra *et al.* (2025) highlight the importance of sustaining workforce capacity in healthcare contexts, underscoring the role of long-term human capital development under conditions of operational strain. In parallel, Khalaf *et al.* (2024) demonstrate that sustainable performance practices enhance organisational agility in hospitality and travel industries, suggesting that sustainability-oriented management approaches contribute to adaptive capacity. Taken together, these findings indirectly support the argument that sustainable workforce development enhances institutional readiness to navigate volatility and disruption, while also pointing to the need for broader empirical investigation across organisational settings.

Organisational Adaptability

Drawing on contingency theory, environmental stressors are posited to induce internal restructuring within organisations. Hrebiniak and Joyce (1985) conceptualise adaptability as an organisational response to environmental determinism, whereby firms adjust structures and processes to maintain alignment with external conditions. Empirical evidence further demonstrates that regulatory and institutional environmental pressures prompt organisations to adopt adaptive strategies, including changes in management systems, sustainability-oriented practices, and strategic reconfiguration (Bansal and Roth, 2000).

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Workforce Sustainability as a Mediator

Beyond these direct effects, workforce sustainability is hypothesised to serve a mediating role between external drivers and organisational adaptability consistent with multilevel organisational research, showing that environmental and technological changes influence performance outcomes primarily through human and organisational processes (Kozlowski and Klein, 2000).

Hypothesis Development

Based on the above theoretical framework, the following hypotheses are proposed:

H1: Environmental pressure has a significant positive effect on workforce sustainability.

H2: AI integration has a significant positive effect on workforce sustainability.

H3: Workforce sustainability has a significant positive effect on organisational adaptability.

H4: Environmental pressure has a significant positive effect on organisational adaptability.

H5: AI integration has a significant positive effect on organisational adaptability.

H6: Workforce sustainability mediates the relationship between environmental pressure and organisational adaptability.

H7: Workforce sustainability mediates the relationship between AI integration and organisational adaptability.

RESEARCH DESIGN AND DATA ANALYSIS

Research Setting and Sampling

The empirical context of this study comprises professionals from various industries within Kuwait, encompassing both public and private sector institutions. A purposive sampling strategy was applied to select individuals in strategic roles, particularly HR professionals, managers, and organisational leaders engaged in digital transformation and sustainability planning. A structured questionnaire was distributed online through professional mailing lists and networks. In total, 272 complete responses were received. This sample reflects a diverse cross-section of the national workforce and is suitable for hypothesis testing using SEM.

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Measures

The measurement scales used in this study were adapted from previously validated instruments. AI integration was assessed using five items evaluating the extent of technological adoption in HR functions (Pandey, 2024). Environmental pressure was captured through five indicators reflecting perceived regulatory, ecological, and economic stressors (Nguyet, 2025; Munziar and Hodijah, 2025). Workforce sustainability was measured using five items covering adaptability, productivity, and well-being (Gutu *et al.*, 2023). Organisational adaptability was assessed via five items related to strategic responsiveness and cultural flexibility (Ma, 2024). All items were rated using a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Prior to the main data collection, the instrument was piloted among 30 professionals to ensure clarity and internal consistency. Each construct demonstrated high reliability, with Cronbach's alpha values exceeding 0.90.

Table 1 presents the demographic profile of the study participants: a total of 272 respondents completed the survey. The gender distribution was relatively balanced, with 51.8% identifying as male and 48.2% as female. The largest age group was 25-34 years (44.5%), followed by 35-44 years (30.1%). Educational attainment was predominantly at the bachelor's level (48.9%), with 26.8% holding a master's degree and 9.6% a doctoral degree. In terms of occupational sector, most respondents worked in the private sector (58.8%), followed by the public sector (33.8%).

Table 1: Demographic Characteristics of Respondents (N = 272)

	Overall (N=272)
Gender	
Male	141 (51.8%)
Female	131 (48.2%)
Age Group	
18-24	12 (4.4%)
25-34	121 (44.5%)
35-44	82 (30.1%)
45-54	39 (14.3%)
55+	18 (6.6%)
Education level	
Other (please specify)	5 (1.8%)
High School	35 (12.9%)
Bachelor	133 (48.9%)
Master	73 (26.8%)
Doctorate	26 (9.6%)

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Occupation	
Public Sector	92 (33.8%)
Private Sector	160 (58.8%)
Self-Employed	20 (7.4%)
What is your current job role?	
Other (please specify)	35 (12.9%)
HR	25 (9.2%)
Management	95 (34.9%)
Technical	65 (23.9%)
Operations	52 (19.1%)
How many years of experience do you have?	
Less than 1 year	3 (1.1%)
1-3 years	49 (18.0%)
4-6 years	83 (30.5%)
7-10 years	44 (16.2%)
More than 10 years	93 (34.2%)

Source: Constructed by authors

DATA ANALYSIS AND RESULTS

The data analysis was conducted in multiple stages to evaluate the psychometric properties of the constructs and to test the hypothesised structural relationships among variables. JAMOVI (Version 2.5) (Gallucci, 2020), an open-source platform integrating R statistical packages, was used for all analyses.

Descriptive statistics were first computed to summarise the demographic characteristics of the sample. Among the 272 respondents, the gender distribution was relatively balanced, with 51.8% identifying as male and 48.2% as female. The age range was broad, with the majority aged between 25 and 44 years. Most participants held a bachelor's degree (48.9%), followed by master's (26.8%) and doctoral degrees (9.6%). In terms of employment, 58.8% were from the private sector and 33.8% from the public sector, reflecting a well-rounded representation of organisational backgrounds.

To assess the reliability of the measurement scales, Cronbach's alpha coefficients were computed. All four constructs, AI integration, environmental pressure, workforce sustainability, and organisational adaptability, demonstrated excellent internal consistency, with α values exceeding 0.90. Item-rest correlations were also above the recommended threshold of 0.50, confirming scale homogeneity and construct reliability.

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Pearson correlation analysis was conducted to explore the relationships among the constructs. AI integration was positively correlated with organisational adaptability ($r = 0.630$, $p < 0.001$) and workforce sustainability ($r = 0.590$, $p < 0.001$). Workforce sustainability and organisational adaptability showed the strongest correlation ($r = 0.777$, $p < 0.001$), suggesting a potential mediating role. Environmental pressure also exhibited significant correlations with workforce sustainability ($r = 0.449$, $p < 0.001$) and organisational adaptability ($r = 0.520$, $p < 0.001$).

SEM was then applied to test the hypothesised model. Direct path analysis showed that AI integration had a significant positive effect on organisational adaptability ($\beta = 0.204$, $p < 0.001$), as did environmental pressure ($\beta = 0.150$, $p < 0.001$). Mediation analysis confirmed that workforce sustainability significantly mediated both relationships. The indirect effect of AI integration on organisational adaptability through workforce sustainability was $\beta = 0.288$ ($p < 0.001$), and the indirect effect of environmental pressure was $\beta = 0.115$ ($p < 0.001$). Bootstrapping with 5,000 samples confirmed the statistical significance of these mediating effects.

The total effects of AI integration ($\beta = 0.492$, $p < 0.001$) and environmental pressure ($\beta = 0.265$, $p < 0.001$) on organisational adaptability further reinforce the importance of workforce sustainability as a mediating construct. These findings provide empirical support for all seven proposed hypotheses (H1-H7), validating the conceptual framework and demonstrating the combined impact of environmental and technological pressures on organisational adaptation outcomes.

Table 2 shows inter-correlations among AI Integration, Environmental Pressure, Workforce Sustainability, and Organisational Adaptability.

Table 2: Pearson Correlation Matrix

	AI Integration	*Environmental Pressure*	*Workforce Sustainability*	*Organisational Adaptability*
AI Integration	—			
Environmental Pressure	0.519 ***	—		
Workforce Sustainability	0.590 ***	0.449 ***	—	
Organisational Adaptability	0.630 ***	0.520 ***	0.777 ***	—

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

Source: Constructed by authors

Bivariate correlations were computed to assess the strength and direction of linear relationships among the latent constructs. As shown in Table 2, all correlations were statistically significant ($p < 0.001$). AI integration was positively correlated with organisational adaptability ($r = 0.630$) and workforce sustainability ($r = 0.590$). Workforce sustainability exhibited the strongest correlation with organisational adaptability ($r = 0.777$), highlighting

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its central role in the model. Environmental pressure also correlated significantly with workforce sustainability (r = 0.449) and adaptability (r = 0.520), suggesting interconnected external and internal adaptation mechanisms.

Reliability and Validity Measure

The reliability and validity of the measurement model were evaluated to confirm internal consistency, unidimensionality, and construct validity of the latent variables. Cronbach's alpha values for all constructs exceeded the acceptable threshold of 0.70, demonstrating strong internal consistency. Specifically, AI Integration (AII) had an alpha of 0.959, Environmental Pressure (EP) 0.909, Organisational Adaptability (OA) 0.890, and Workforce Sustainability (WS) 0.878, all indicating good to excellent reliability.

Composite reliability was also examined using both rho_A and rho_C coefficients. All constructs showed rho_A and rho_C values above the 0.70 benchmark, with rho_C values ranging from 0.911 to 0.968, further confirming construct reliability.

To assess convergent validity, Average Variance Extracted (AVE) values were reviewed. AVE scores for all constructs exceeded the threshold of 0.50, with AII at 0.859, EP at 0.732, OA at 0.695, and WS at 0.673. These results support convergent validity, as recommended by Chin (1998) and Fornell and Larcker (1981), indicating that each construct explains more than 50% of the variance in its indicators.

Discriminant validity was established using the Fornell-Larcker criterion, whereby the square root of each construct's AVE exceeded its correlations with any other construct. Additionally, cross-loading checks confirmed that all indicators loaded highest on their intended constructs. These findings confirm that each latent variable is distinct from the others in the model.

Overall, the measurement model demonstrated strong psychometric properties, ensuring confidence in the reliability and validity of the instrument. These results support the use of SEM to test the hypothesised relationships in the conceptual framework (Table 3).

Table 3: Reliability and Convergent Validity Metrics for the Measurement Model Constructs

	Cronbach's alpha	*Composite reliability (rho_a)*	*Composite reliability (rho_c)*	*Average variance extracted (AVE)*
AII	0.959	0.961	0.968	0.859
EP	0.909	0.930	*0.932*	0.732
OA	0.890	0.892	0.919	0.695
WS	0.878	0.883	0.911	0.673

Source: Constructed by authors

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Evaluation of the Structural Model

Following the confirmation of construct reliability and validity, the structural model was evaluated to test the hypothesised relationships among variables. SEM was conducted using the lavaan package via JAMOVI with a bootstrapping procedure of 5,000 samples to ensure statistical robustness (Rosseel, 2012).

The model demonstrated good explanatory power, with workforce sustainability explaining a substantial proportion of variance in organisational adaptability ($R2 = 0.604$). The standardised path coefficients were all significant and aligned with the hypothesised directions.

AI integration showed a significant direct effect on organisational adaptability ($\beta = 0.204$, $p < 0.001$), as did environmental pressure ($\beta = 0.150$, $p < 0.001$), supporting H4 and H5. Workforce sustainability was also significantly predicted by both AI integration ($\beta = 0.476$, $p < 0.001$) and environmental pressure ($\beta = 0.327$, $p < 0.001$), confirming H1 and H2. Furthermore, workforce sustainability had a strong direct effect on organisational adaptability ($\beta = 0.492$, $p < 0.001$), providing empirical support for H3.

To test mediation effects, indirect pathways were examined. The indirect effect of AI integration on organisational adaptability through workforce sustainability was significant ($\beta = 0.288$, 95% CI [0.1218, 0.252], $p < 0.001$), confirming H7. Similarly, environmental pressure exhibited a significant indirect effect ($\beta = 0.115$, 95% CI [0.0349, 0.123], $p < 0.001$), supporting H6. These results validate the mediating role of workforce sustainability in translating external technological and environmental factors into organisational adaptability (Table 4 and Figure 1).

Overall, the structural model demonstrated strong empirical fit, and all seven hypotheses (H1-H7) were supported. These findings affirm the relevance of integrating environmental and technological drivers into HR systems to enhance organisational adaptability via sustainable workforce practices.

Table 4: Summary of SEM Path Coefficients

Pathway	*Effect Type*	*β*	*SE*	*95% CI*	*p*
AI → WS → OA	Indirect	0.288	0.0251	[0.1218, 0.252]	< 0.001
EP → WS → OA	Indirect	0.115	*0.0235*	[0.0349, 0.123]	< 0.001
AI → OA	Direct	0.204	0.0295	[0.0669, 0.204]	< 0.001
EP → OA	Direct	0.150	0.0289	[0.0417, 0.169]	< 0.001
AI → OA (Total)	Total	0.492	*0.0335*	[0.2260, 0.403]	< 0.001
EP → OA (Total)	Total	0.265	0.0363	[0.1018, 0.262]	< 0.001

Source: Constructed by authors

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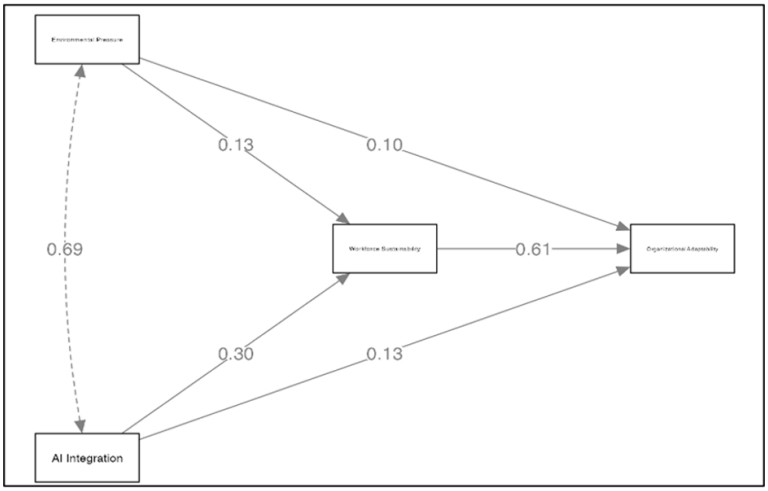

Figure 1: Structural Equation Model Illustrating the Effects of Environmental Pressure and AI Integration on Workforce Sustainability and Organisational Adaptability

Source: Constructed by authors

DISCUSSIONS AND CONCLUSIONS

This study advances our understanding of how environmental pressure and AI integration collectively shape organisational adaptability through the mediating role of workforce sustainability. Situated within the SEM framework, this research provides robust empirical validation for a multi-construct model that addresses a critical gap in HR resilience literature, particularly within the Gulf region. Consistent with contingency theory (Donaldson, 2001), the findings demonstrate that organisational adaptability arises from aligning internal workforce capabilities with external environmental and technological demands. The observed positive effects of environmental pressure and AI integration reflect the necessity of structural and strategic fit.

The findings reveal that environmental pressure significantly enhances workforce sustainability (H1), echoing the assertions of Nguyet (2025) and Munziar and Hodijah (2025). Regulatory mandates and sustainability expectations act as catalysts for organisations to adopt long-term, employee-centred strategies, but their effectiveness depends on alignment with internal HR values and practices (Renwick *et al.*, 2013). In parallel, AI integration demonstrates a significant influence on workforce sustainability (H2), consistent with the work of Pandey (2024). When thoughtfully integrated, AI enables proactive workforce planning and continuous performance monitoring. Employee trust in AI systems enhances morale and retention, reinforcing sustainability outcomes (Tarigan, 2025).

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Workforce sustainability emerged as a strong predictor of organisational adaptability (H3). Organisations that invest in continuous learning, well-being, and adaptability of their workforce are better positioned to manage external disruptions. The direct effects of environmental pressure (H4) and AI integration (H5) on organisational adaptability further affirm the relevance of contingency theory and sociotechnical systems theory. As noted by Hrebiniak and Joyce (1985), environmental stressors drive internal restructuring. AI-enabled systems enhance forecasting and decision-making. In line with sociotechnical systems theory (Trist and Emery, 1973), the findings highlight that workforce sustainability mediates the influence of technical (AI) and environmental systems on adaptability, underscoring the importance of jointly optimising human and technological elements in HR systems.

Importantly, workforce sustainability was found to mediate both the AI-adaptability (H6) and environmental pressure-adaptability (H7) relationships. These mediation effects position workforce sustainability as a strategic buffer that transforms external challenges into internal adaptive capacity (Alkandari *et al.*, 2024). In Kuwait, where top-down initiatives such as Vision 2035 guide reforms, internal workforce resilience is key to meaningful adaptation.

From a theoretical standpoint, this study contributes to the current literature by integrating environmental and technological disruptions into a cohesive HR resilience model. It extends current literature by revealing the synergistic influence of AI and ecological forces on organisational adaptability. Methodologically, the use of SEM with bootstrapping adds rigor and provides a valuable empirical base for future investigations, especially in under-explored regional contexts.

Organisations, particularly in Gulf countries undergoing Vision 2035 transformations, should prioritise workforce sustainability as a strategic imperative (Al-Dashti *et al.*, 2022). This includes investing in employee upskilling, promoting environmental literacy, and fostering ethical AI adoption. Such investments not only enhance adaptability but also future-proof human capital strategies. Despite its contributions, the study is constrained by its cross-sectional design and its focus on Kuwaiti institutions. Future research should adopt longitudinal designs, expand the geographical scope, and examine moderating variables such as industry type, organisational size, or cultural orientations towards technology and sustainability.

This research underscores the pivotal role of workforce sustainability in enabling organisations to adapt to the dual challenges of climate change and digital transformation. By validating the mediating role of sustainable HR practices, the findings provide actionable insights for HR leaders and policy-makers aiming to build resilient, agile organisations. As the global business environment continues to evolve, the ability of HR systems to absorb shocks and sustain performance will define long-term organisational success.

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Data Availability Statement

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval/Informed Consent

The study was conducted following ethical standards. Ethical approval was obtained from the Research Ethics Committee of the Kuwait Technical Collage. Informed consent was obtained from all individual participants included in the study.

Conflict of Interest

The authors declare that there are no conflicts of interest relevant to this study.

Author Contributions

Shaikhah Alainati: Conceptualisation, Methodology, Writing – Original Draft, Data Collection.

Anfal Albadir: Data Analysis, Writing – Review and Editing, Visualisation.

Mariam Alterkait: Literature Review, Project Administration, Supervision.

AA Alhunaiyyan: Statistical Modelling, Software, Technical Validation.

Anwaar Alkandari: Data modelling, Source data, Writing – Review and Editing

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BIOGRAPHY

Dr Shaikhah Alainati is the Head of the Management Department at the College of Business Studies, Public Authority for Applied Education and Training (PAAET). She is an Associate Professor specialising in Human Resource Management (HRM) and holds a PhD in HRM. Her research interests span HRM, AI in the workplace, employee performance, competencies, and innovation. Dr Alainati has authored several peer-reviewed articles in international journals and actively supervises postgraduate research. She regularly delivers MBA and executive training programmes focused on leadership, change management, and workforce development, and she is also involved in curriculum design and national research initiatives supporting Kuwait Vision 2035. Fluent in Arabic and English, she is passionate about bridging academic research with real-world impact.

Dr Anfal Albader is an Assistant Professor at the College of Business Studies in Kuwait, with over 14 years of teaching experience in higher education. She holds a PhD in Development Policy and Management from the University of Manchester, UK. Her academic interests include digital transformation, human resource practices, and the role of ICT in knowledge management and sustainability.

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Dr Mariam A. Alterkait is an Assistant Professor of Management Information Systems (MIS) at the College of Business Studies, Public Authority for Applied Education and Training (PAAET), Kuwait. She earned her Master's degree in MIS from the University of Surrey, UK, in 2010, and completed her PhD in MIS at the University of Leeds, UK, in 2019. Dr Alterkait's research interests focus on emerging digital technologies, artificial intelligence (AI), small and medium-sized enterprises (SMEs), and supply chain management. She has participated in and attended several academic conferences in the fields of management and information systems.

Professor Ahmed Al-Hunaiyyan currently act as Deputy Director for Applied Education and Research at The Public Authority for Applied Education and Training. He is the Former Dean of the College of Business Studies, and a faculty member in the Department of Computer and Information Systems at the College of Business Studies, PAAET, Kuwait. He earned his PhD in the field of Computer Science, specialising in multimedia interface design, from Hertfordshire University, UK. Dr Al-Hunaiyyan has worked in various academic institutions, Al-Ain University, U.A.E., Waubonsie College, USA, Hertfordshire University, UK, Public Authority for Applied Education and Training (PAAET), Kuwait, Gulf University for Science and Technology (GUST), and Kuwait University. He has research contributions in journals, conferences, and books in fields related to human-computer interaction (HCI), software and system design, usability, UX, eLearning platform, cultural and ethical issues related to information technology.

Dr Anwaar Al-Kandari is the Head of the Business Management School at Kuwait Technical College (KTech), where she also chairs the college's annual conference. She serves as an Assistant Professor of Business and Management, with research interests in management, organisational behaviour, and digital transformation. Dr Al-Kandari has contributed to academic publications on topics such as brand identification and consumer behaviour in Kuwait, and her work aligns with several UN Sustainable Development Goals, including Quality Education and Economic Growth. She has played a leading role in advancing business education in Kuwait, supporting KTech's membership in the AACSB Business Education Alliance, and actively participates in regional academic and professional events related to entrepreneurship and sustainability.

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